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NAS FORT WORTH
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FINAL FIELD SAMPLING PLAN FOR SITE CHARACTERIZATION OF BASE SERVICE STATION VOLUME 1 NAS FORT WORTH TX

7/1/1996

INTERNATIONAL TECHNOLOGIES

File: 17G
A.F.
293000

NAVAL AIR STATION
FORT WORTH JRB
CARSWELL FIELD
TEXAS

ADMINISTRATIVE RECORD
COVER SHEET

AR File Number 298

HQ Air Force Center for Environmental Excellence

Final
Field Sampling Plan
Volume 1

Prepared for:

Site Characterization of Base Gas Station
Naval Air Station Fort Worth Joint Reserve Base
Carswell Field, Texas

F41624-94-D8047-032
Project No. 765725

July 1996

298002

13 May 96

MEMORANDUM FOR: ERB (Mr Rice)

FROM: ERC (Ms Smith-Townsend)

SUBJECT: Draft Work Plan, Draft Quality Assurance Project Plan, vol II, and Draft Site Health and Safety Plan, Site Characterization of Base Gas Station, Naval Air Station Fort Worth Joint Reserve Base, Carswell Field, TX, April 1996, prepared by IT Corporation, Knoxville, TN (ERC Log 353)

I have reviewed the above referenced documents from the standpoint of risk assessment, and have the following comments. I found nothing in the Quality Assurance Program Plan relating specifically to risk assessment. In the Draft Work Plan risk assessment was addressed in one paragraph at the end of the document. It is apparent that risk assessment is an afterthought in this Work Plan. This is a fatal flaw, since the results of the risk assessment should be the primary supporting rationale for performing any follow-on remediation. Remediation performed without knowing if risk to human health and/or the environment exists, or that the proposed remedy will alleviate it, is a potential waste of money. In addition, all site assessment activities should be undertaken with a conceptual site model for human health and environmental risk in mind. The conceptual site model should guide the investigation from beginning to end. It defines the potential problem, is the mechanism through which data gaps are identified, and is the basis for determining whether the remediation undertaken has been successful or not. The Work Plan should be largely rewritten to incorporate a conceptual site model reflecting what is already known about the site from previous investigations by other contractors, and presenting the approach to risk assessment which will define data gaps and clean up levels.

There is nothing specifically relating to risk assessment in the Draft Health and Safety Plan However, my review for completeness and continuity reveals some deficiencies which are included in the attached table of comments. The deficiencies in the Draft Health and Safety Plan are not show stoppers, and can easily by corrected by the contractor.

BARBARA SMITH-TOWNSEND, GM-13
Environmental Scientist, ERC

Coordination:

Dr William Sweet: ....

298003

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE CENTER FOR ENVIRONMENTAL EXC
BROOKS AIR FORCE BASE TEXAS

April 9, 1996

MEMORANDUM FOR ERB
ATTENTION: Charles Rice

FROM: ERC (Roger Peebles)

SUBJECT: Draft Work Plan, Field Sampling Plan, Health and Safety Plan and Quality Assurance Project Plan, Naval Air Station Forth Worth Joint Reserve Base, Carswell Field, Texas, April 1996. Prepared by IT Corporation

1. I have reviewed the above referenced documents and have the following comments concerning hydrology:

a. General comments:

I have reviewed the Work Plan and Field Sampling Plan. Both plans are adequate. I have some specific comments on the Field Sampling Plan which are given below.

b. Specific comments:

Section 3.3.1 Soil Coring , Soil Boring, and Monitoring Well Locations.

The soil corings BGST-1 through BGST-5 are not shown in Figure 3-2 as indicated in the text.

The section states that two samples will be collected from each borehole which will then be converted to monitoring wells and are shown in Figure 3.2. These boreholes are not shown in this figure. Correct this error.

Include or overlay a water table/piezometric surface contour in this section so that the placement of up/down gradient wells can be evaluated.

Section 3.3.2 Horizontal Conduit Assessment

Transect 7 is not shown in Figure 3.2 as indicated in the text. Correct this error. Lines BGSL101 and BGSL103 are not shown on Figure 3.3 as indicated in the text. Correct this error.

Section 3.4.1. Soils

IT states that natural lithology could provide a preferential pathway. Define what lithologies will qualify as preferential pathways and how the extent and direction of a pathway will be determined.

298004

Section 3.4.2 Groundwater

Text on Page 7 states that groundwater samples will be analyzed for TMB and PAH. These are not shown in Table 3-4 under the column headed 1st Sampling. Explain this discrepancy.

2. I appreciate the opportunity to review this document. If you have any questions or if I can be of any further assistance, please contact me at 4-5683.

Let me know if you have questions.

Roger Peebles
ERC
4-5683

298005

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
BROOKS AIR FORCE BASE TEXAS

23 APR 1996

MEMORANDUM FOR ERB
ATTENTION: Mr. C. Rice

FROM: ERC (Dr. E.S. Berman)

SUBJECT. DRAFT - WORK PLAN,
SAMPLING & ANALYSIS PLAN (QAPP),
FIELD SAMPLING PLAN, AND
HEALTH & SAFETY PLAN
BASE SERVICE STATION & BASE GAS STATION
CARSWELL AFB
APRIL 1996
(ERC #355)

CONTRACTOR: IT CORPORATION

ERC Engineering has performed the requested review on the subject documents. Comments are as follows:

Work Plan

1. Figure 2.1 needs to show/ highlight the areas surrounding Carswell AFB more clearly. It would be helpful if this map was in color.

2. Subsection 2.3.1 (Base Service Station Site History) appears to be out of place with respect with the remaining sections within Section 2.3. Since the remaining subsections in Section 2.3 cover general base geology / hydrogeology, it is recommended that they be combined with Section 2.2, which also cover general base terrain and water characteristics.

3. Subsection 2.3.4.

A. What is the depth to groundwater at the Base Service Station and Base Gas Station?

B. What are the depths of the current monitoring wells (MW-4 through MW-12) at the Base Service Station?

C. What are the depths of the recovery wells, SAV-1 and SAV-2, at the Base Service Station?

4. Subsection 3.2.2.2. Are the proposed two sampling events (one at well installation and the other 3 months later), from the newly installed monitoring wells at the Base Gas Station, going to provide sufficient knowledge on the amount of free product at this site? Subsections 3.1.1.2 and 3.1.1.5 both state that the amount of free product detected at other sites at Carswell AFB varies seasonally. Also, during which season(s) is(are) the proposed sampling to occur?

Sampling & Analysis Plan (QAPP)

No engineering comments.

Field Sampling Plan (FSP)

1. The FSP does not cover sampling at the Base Service Station. Isn't there going to sampling at this location too?

2. Subsection 3.4.2. Same question as #4, under the Work Plan.

Health & Safety Plan (HSP)

No engineering comments.

If you have any questions, please feel free to contact me at 4-4171.

Dr. E.S. Berman
Chemical Engineer
Consulting Operations Division

ERC Engineering Concurrence

____
Mr. C. Yen

298007

FINAL
FIELD SAMPLING PLAN
For
Site Characterization of Base Gas Station
Volume 1 of 2 of the Sampling and Analysis Plan

for
Naval Air Station Fort Worth
Fort Worth, Texas
Revision 1, July 1996

Approved:	______________ IT QA/QC Manager	Date 7/8/96
Approved:	______________ IT Project Manager	Date 7/8/96
Approved:	______________ TNRCC	Date ______________
Approved:	______________ AFCEE Team Chief	Date ______________

F41624-94-D8047-032

298008

Final

Field Sampling Plan
Remedial Investigation Base Gas Station
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field
Fort Worth, Texas
Facility ID No. 009696

Prepared for:

Air Force Center for Environmental Excellence
Brooks Air Force Base, Texas
Contract No. F41624-94-D-8047
Delivery Order No. 0032

Prepared by:

IT Corporation
312 Directors Drive
Knoxville, Tennessee 37923

Project No. 765725
Revision 1

July 1996

 298009

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298012

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List of Acronyms

AA	atomic absorption
AFCEE	Air Force Center for Environmental Excellence
API	American Petroleum Institute
ARAR	applicable or relevant and appropriate requirement
AST	aboveground storage tanks
ASTM	American Society for Testing and Materials
bgs	below ground surface
Br^-	bromide
BTEX	benzene, toluene, ethyl benzene, and xylene
°C	degrees Celsius
CAB	cellulose acetate butyrate
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulation
Cl^-	chloride
cm/sec	centimeters per second
COC	chain of custody
COR	contracting officer representative
CPT	cone penetrometer test
DERP	Defense Environmental Restoration Program
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DOD	Department of Defense
DOT	Department of Transportation
DNAPL	dense nonaqueous phase liquid
DQO	Data Quality Objective
EC	electrical conductivity
EDB	ethylene dibromide
EPA	Environmental Protection Agency

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List of Acronyms *(Continued)*

F^-	fluoride
FID	flame ionization detector
FSP	Field Sampling Plan
g	gammas
g/cm^3	grams per cubic centimeter
G	glass
GPR	ground penetrating radar
HSP	Health and Safety Plan
H_2SO_4	sulfuric acid
Handbook	Handbook for the Installation Restoration Program (IRP) Remedial Investigation and Feasibility Studies (RI/FS), September 1993
HCl	hydrochloric acid
HNO_3	nitric acid
HSA	hollow-stem auger
IAW	in accordance with
IRP	Installation Restoration Program
IRPIMS	Installation Restoration Program Information Management System
IT	IT Corporation
lb/gal	pounds per gallon
LNAPL	light nonaqueous phase liquid
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL	milliliter
MTBE	methyl tertiary butyl ether
NAS Fort Worth	Naval Air Station Fort Worth
$Na_2S_2O_3$	sodium thiosulfate
NCP	National Contingency Plan
NO_2^-	nitrite
NO_3^-	nitrate
OD	outside diameter

List of Acronyms (Continued)

OSHA	Occupational Safety and Health Administration
OVA	organic vapor analyzer
P	polyethylene
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PET	polyethylene terephthalate
PID	photoionization detector
PO_4^{-3}	phosphate
PPE	personal protective equipment
PVC	polyvinyl chloride
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SO_4^{-2}	sulfate
SOW	statement of work
SP	spontaneous potential
T	California brass
TDS	total dissolved solids
TIC	tentatively identified compound
TMB	trimethyl benzene
TPH	total petroleum hydrocarbons
TNRCC	Texas Natural Resource Conservation Commission
TWC	Texas Water Commission
USCS	Unified Soil Classification System

298016

List of Acronyms (Continued)

USGS	U.S. Geological Survey
UST	underground storage tank
VOC	volatile organic compound
WP	work plan

298017

Preface

This field sampling plan (FSP) prepared by IT Corporation (IT) is for site characterization of the Base Gas Station, Naval Air Station (NAS) Fort Worth Joint Reserve Base, Carswell Field, Texas (NAS Fort Worth). The location of NAS Fort Worth and the Base Gas Station are shown on Figures 2-1 and 2-2.

The FSP is Part 1 of the sampling and analysis plan (SAP). The quality assurance project plan (QAPP) is Part 2. The FSP includes sample locations, sampling frequency, and analytical methods; also, a detailed description of the field methods; and a detailed description of the analytical methods.

Work under this FSP will include investigation of potentially contaminated soil and groundwater at the Base Gas Station, potential contaminant migration pathways between the Base Gas Station and Base Service Station, and surface water fuel-related contamination in the Trinity River immediately east of the Base Service Station.

Appendix A contains a list of personnel who will be responsible for completing this work.

A schedule for the performance of the site characterization is also included as part of Appendix A. The field effort will begin in July 1996 and be completed in November 1996.

298018

TAB

1.0

 298019

1.0 Introduction

This Field Sampling Plan is for site characterization of the Base Gas Station, Naval Air Station (NAS) Fort Worth Joint Reserve Base, Carswell Field, Texas (NAS Fort Worth). The location of NAS Fort Worth and the Base Gas Station are shown on Figures 2-1 and 2-2.

The FSP presents, in specific terms, the requirements and procedures for conducting field operations and investigations. This project-specific FSP has been prepared to ensure (1) the data quality objectives specified for this project are met, (2) the field sampling protocols are documented and reviewed in a consistent manner, and (3) the data collected are scientifically valid and defensible. This site-specific FSP and the quality assurance project plan (QAPP), shall constitute, by definition, a sampling and analysis plan (SAP).

The National Contingency Plan (NCP) specifies circumstances under which an FSP is necessary for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) response actions. For cleanup actions at the remedial investigation/feasibility study (RI/FS) stage, the NCP requires lead agents to develop SAPs that provide a process for obtaining data of sufficient quality and quantity to satisfy data needs. Such SAPs must include an FSP (Title 40 Code of Federal Regulations [CFR] Part 300.430 [b][8][ii]).

Guidelines followed in the preparation of this plan are set out in the: *Data Quality Objectives Process for Superfund, Interim Final Guidance* (EPA, 1993). This FSP is to be used in conjunction with the *Work Plan, QAPP, and Health and Safety Plan* for investigations at NAS Fort Worth.

This FSP is required reading for all staff participating in the work effort. The FSP shall be in the possession of the field teams collecting the samples. All contractors and subcontractors shall be required to comply with the procedures documented in this FSP, which are applicable to their respective Statement of Works (SOW). This will assure that they maintain comparability and representativeness of the collected and generated data. In all instances where "contractor" is specified this will mean "IT." Subcontracts executed during the production of this work will be

298020

identified as part of the project reporting and the applicable requirements of this FSP will be communicated to their personnel.

Controlled distribution of the FSP shall be implemented by the prime contractor to ensure the current approved version is being used. A sequential numbering system shall be used to identify controlled copies of the FSP. Controlled copies shall be provided to applicable Air Force managers, regulatory agencies, remedial project managers, project managers, and quality assurance (QA) coordinators. Whenever Air Force revisions are made or addenda added to the FSP, a document control system shall be put into place to ensure (1) all parties holding a controlled copy of the FSP shall receive the revisions/addenda and (2) outdated material is removed from circulation. The document control system does not preclude making and using copies of the FSP; however, the holders of controlled copies are responsible for distributing additional material to update any copies within their organizations. The distribution list for controlled copies shall be maintained by the contractor.

298021

TAB

2.0

298022

2.0 Project Background

2.1 The U.S. Air Force Installation Restoration Program

The objective of the U.S. Air Force Installation Restoration Program (IRP) is to assess past hazardous waste disposal and spill sites at U.S. Air Force installations and to develop remedial actions consistent with the NCP for sites that pose a threat to human health and welfare or the environment. This section presents information on the program origins, objectives, and organization.

The 1976 Resource Conservation and Recovery Act (RCRA) is one of the primary federal laws governing the disposal of hazardous wastes. Sections 6001 and 6003 of RCRA require federal agencies to comply with local and state environmental regulations and provide information to the EPA concerning past disposal practices at federal sites. RCRA Section 3012 requires state agencies to inventory past hazardous waste disposal sites and provide information to the EPA concerning those sites.

In 1980, Congress enacted CERCLA (Superfund). CERCLA outlines the responsibility for identifying and remediating contaminated sites in the United States and its possessions. The CERCLA legislation identifies the EPA as the primary policy and enforcement agency regarding contaminated sites.

The 1986 Superfund Amendments and Reauthorization Act (SARA) extends the requirements of CERCLA and modifies CERCLA with respect to goals for remediation and the steps that lead to the selection of a remedial process. Under SARA, technologies that provide permanent removal or destruction of a contaminant are preferable to action that only contains or isolates the contaminant. SARA also provides for greater interaction with public and state agencies and extends the EPA's role in evaluating health risks associated with contamination. Under SARA, early determination of Applicable or Relevant and Appropriate Requirements (ARAR) is required, and the consideration of potential remediation alternatives is recommended at the initiation of an RI/FS. SARA is the primary legislation governing remedial action at past hazardous waste disposal sites.

Executive Order 12580, adopted in 1987, gave various federal agencies, including the Department of Defense (DOD), the responsibility to act as lead agencies for conducting investigations and implementing remediation efforts when they are the sole or co-contributor to contamination on or off their properties.

To ensure compliance with CERCLA, its regulations, and Executive Order 12580, the DOD developed the IRP, under the Defense Environmental Restoration Program (DERP), to identify potentially contaminated sites, investigate these sites, and evaluate and select remedial actions for potentially contaminated facilities. The DOD issued the Defense Environmental Quality Program Policy Memorandum (DEQPPM) 80-6 regarding the IRP program in June 1980, and implemented the policies outlined in this memorandum in December 1980. The NCP was issued by EPA in 1980 to provide guidance on a process by which (1) contaminant release could be reported, (2) contamination could be identified and quantified, and (3) remedial actions could be selected. The NCP describes the responsibility of federal and state governments and those responsible for contaminant releases.

The DOD formally revised and expanded the existing IRP directives and amplified all previous directives and memoranda concerning the IRP through DEQPPM 81-5, dated December 11, 1981. The memorandum was implemented by a U.S. Air Force message dated January 21, 1982.

The IRP is the DOD's primary mechanism for response actions on U.S. Air Force installations affected by the provisions of SARA. In November 1986, in response to SARA and other EPA interim guidance, the U.S. Air Force modified the IRP to provide for an RI/FS program. The IRP was modified so that RI/FS studies could be conducted as parallel activities rather than serial activities. The program now includes ARAR determinations, identification and screening of technologies, and development of alternatives. The IRP may include multiple field activities and pilot studies prior to a detailed final analysis of alternatives. Over the years, requirements of the IRP have been developed and modified to ensure that DOD compliance with federal laws, such as RCRA, NCP, CERCLA, and SARA, can be met.

2.2 Project Purpose And Scope

The purpose and scope of the field sampling at the Base Gas Station are to:

- Characterize the nature and extent of any soil and groundwater fuels contamination at the former tank location.

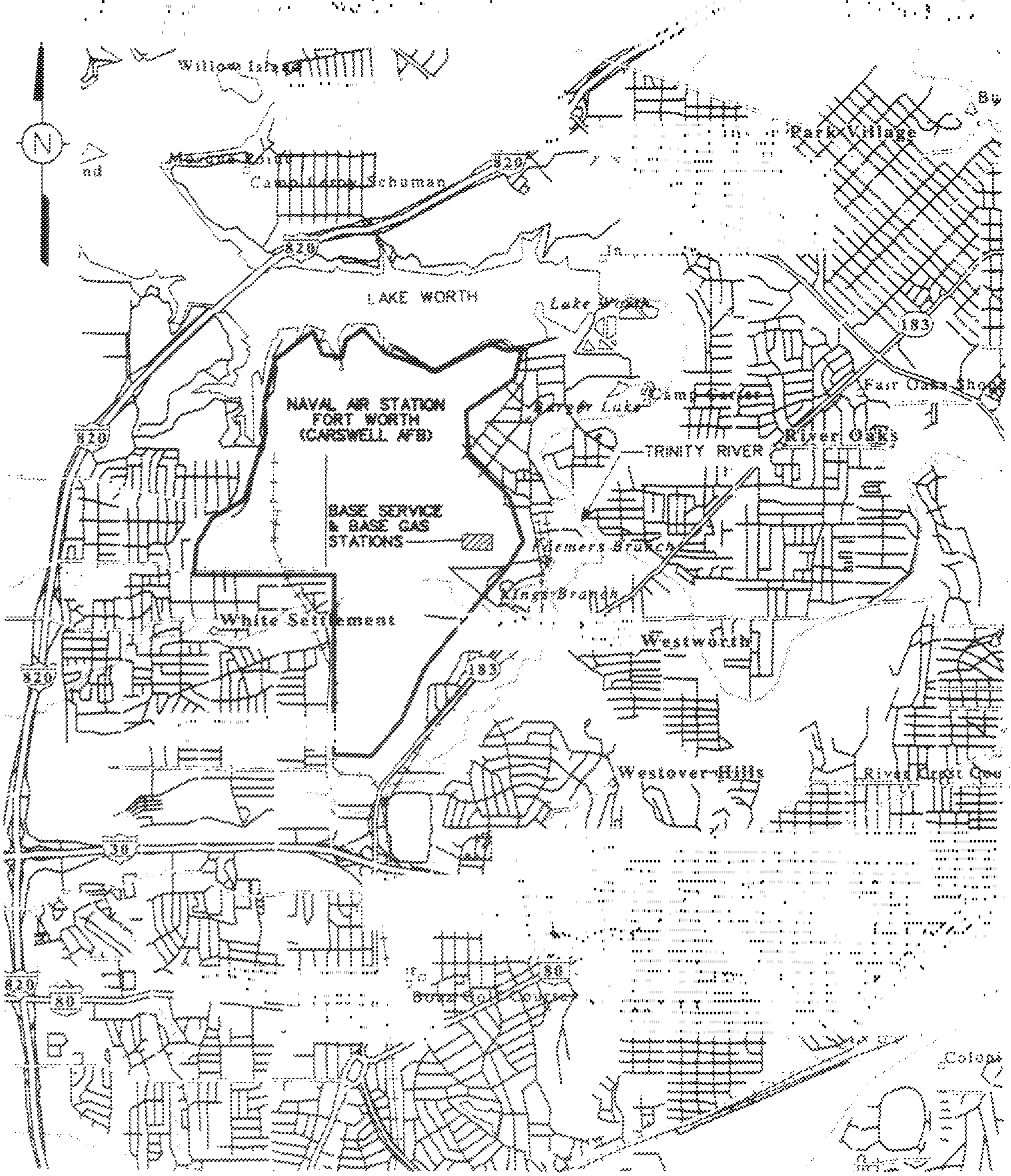
- Characterize the background and downgradient fuel contaminant levels.
- Characterize the concentrations of any fuel contaminant present in the soil between the Base Gas Station and the Base Service Station.
- Determine if utility lines are acting as conduits for lateral migration of contaminants from the Base Gas Station.
- Document and characterize any seepage of fuels into the West Fork of the Trinity River.
- Remove any free product encountered in monitoring wells.
- Acquire analytical data needed to assess the potential success of in situ bioremediation and other remedial technologies.

2.3 Project Site Description

NAS Fort Worth Joint Reserve Base is located in north-central Texas in Tarrant County, 8 miles west of downtown Fort Worth (Figure 2-1). The base property, totaling 2,555 acres, consists of the main base and two, noncontiguous parcels. The main base comprises 2,264 acres and is bordered by Lake Worth to the north, the West Fork of the Trinity River and Westworth Village to the east, Fort Worth to the northeast and southeast, White Settlement to the west and southwest, and AF Plant 4 to the west. The area surrounding NAS Fort Worth is mostly suburban, including the residential areas of the cities of Fort Worth, Westworth Village, and White Settlement. The base was home to Carswell Air Force Base prior to realignment to NAS Fort Worth in 1991.

The Base Gas Station occupied about 45,000 square feet on the northeast corner of Knights Lake Road and Warehouse Street at NAS Fort Worth (Figure 2-2).

The Base Gas Station was originally constructed as a gas station in the 1950s and had three underground storage tanks (UST). Sometime in the 1960s or 1970s the facility was converted to an aboveground storage tank (AST) facility with fuel dispensing facilities. The facility was active until 1989 when operations were ceased and the facility was left unused until 1994. In February 1994, Metcalf and Eddy, under contract to Air Force Center for Environmental Excellence (AFCEE), dismantled and removed the ASTs and other associated equipment from the former Base Gas Station.



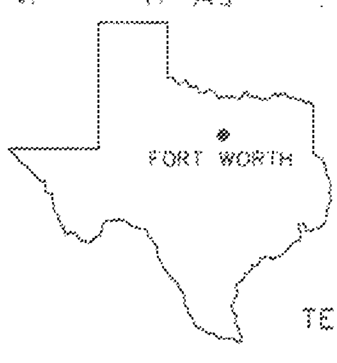


FIGURE 2-1
SITE LOCATION MAP

NAVAL AIR STATION FORT WORTH
FORT WORTH, TEXAS

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 3/20/96 | DATE LAST REV.: | DRAFT. CHCK. BY: C.TUMLIN | INITIATOR: W.CARTER | DWG NO. 765723
DRAWN BY: K.BLAIR | DRAWN BY: | ENGR. CHCK. BY: W.CARTER | PROJ. MGR.: W.CARTER | PROJ. NO. 76572

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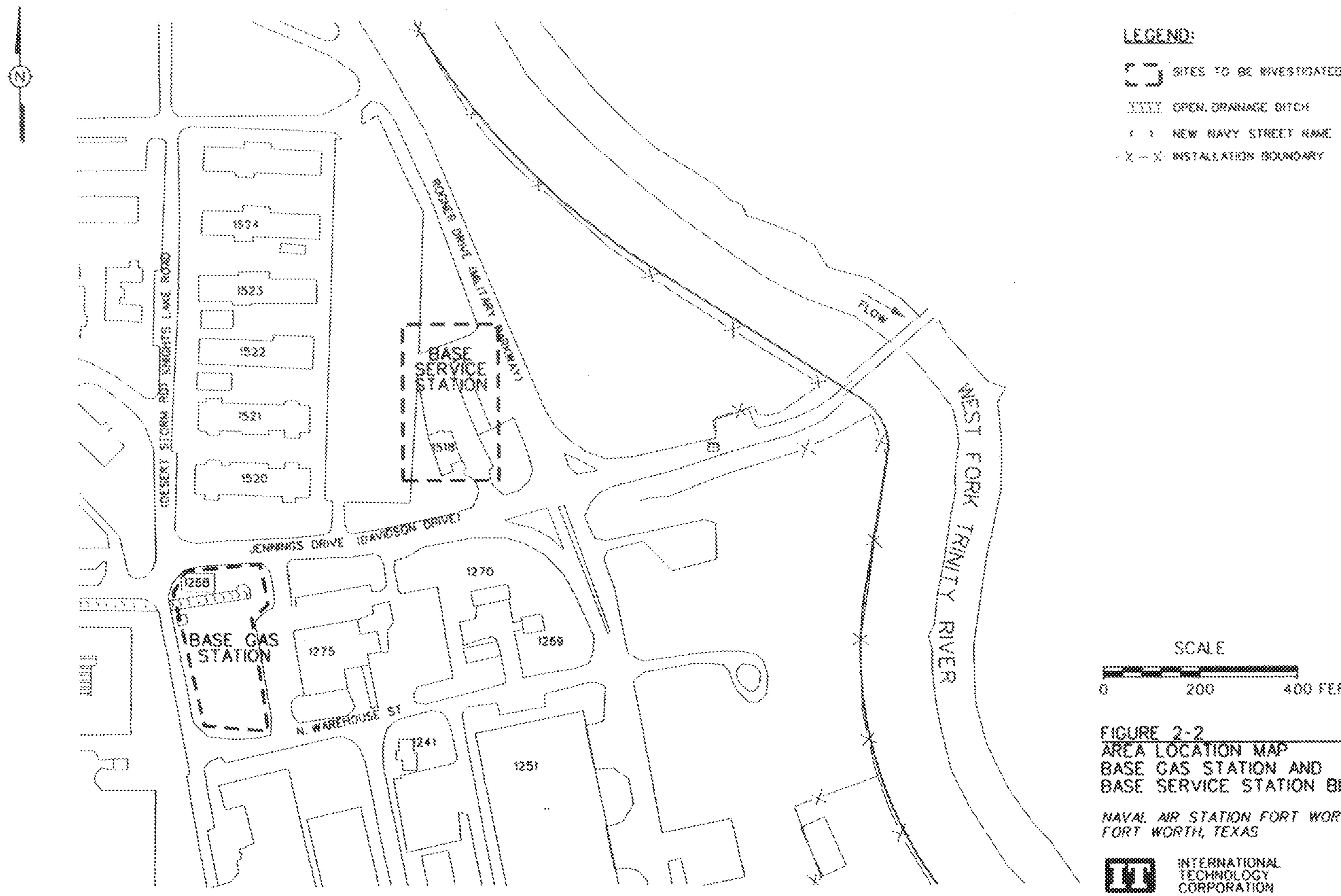


FIGURE 2-2
AREA LOCATION MAP
BASE GAS STATION AND
BASE SERVICE STATION BLDG 1518

NAVAL AIR STATION FORT WORTH
FORT WORTH, TEXAS

INTERNATIONAL
TECHNOLOGY
CORPORATION

The facility consisted of :

- One 12,000-gallon diesel fuel AST
- One 12,000-gallon unleaded fuel AST
- One 6,000-gallon unleaded fuel AST
- Three 12,000-gallon regular fuel ASTs
- Concrete foundations for the tanks
- Above and below ground piping
- Fuel dispensing island
- Miscellaneous structures such as pumphouse and filling area
- Fencing and berms to contain spills.

The facility remained in operation until 1989, and was demolished in 1994.

2.4 Project Site Contamination History

During the removal action of the ASTs and ancillary equipment at the Base Gas Station, it was discovered that the soil might have been impacted at the facility. Field screening and visual observations determined that areas might be impacted with petroleum hydrocarbons. Soil samples were collected from both surface locations near site equipment as well as at depth from test pits dug at two areas. One test pit was dug to 13 feet in depth near the center of the ASTs near the tank foundations. Water appeared at 10.5 feet below surface with a strong odor and had a product layer on the surface. The second test pit was dug to a depth of 13 feet near the north end of the site. Upon reaching the final excavation depth, the test pit began to fill with water that had a product sheen (Metcalf & Eddy, 1994).

Thirteen soil samples and one water sample were collected from various areas of the Base Gas Station. Elevated concentrations of petroleum hydrocarbons were detected in the surface soil samples at the Knights Lake Road fuel island, the gasoline pumping unit closest to the fuel island, and at equipment near the south end of the site. Laboratory analysis indicated soil concentrations ranged from nondetect to 23,000 milligrams per kg (mg/kg) for total petroleum hydrocarbons (TPH) and from nondetect to 281 mg/kg for total benzene, toluene, ethyl benzene, and xylene (BTEX). Subsurface soil samples indicated elevated concentrations of petroleum hydrocarbons (maximum concentrations of 78 mg/kg total BTEX and 2,300 mg/kg TPH) in Test Pit No.1, located at the ASTs. Elevated concentrations of lead up to 180 mg/kg were detected at the Base Gas Station pumping unit from surface soil samples. The groundwater sample collected from test pit No.1 indicated elevated concentrations of petroleum hydrocarbons.

In April 1992, a petroleum seep was noted along the west bank of the Trinity River about 500 feet downgradient of the Base Service Station. The petroleum seep was reported to the Texas Water Commission (TWC), which issued a Notice of Violation for the release to the river.

In September 1992, the Base Service Station USTs were tested for integrity; three tanks failed the integrity testing. TWC was notified and requested immediate removal of free product discovered in monitor well Base Service Station B. Gasoline sales were terminated at the Base Service Station in the middle of September 1992.

298029

TAB

3.0

298030

3.0 Project Scope and Objectives

3.1 Objectives

The data quality objectives (DQO) for this FSP are specified in Section 4.0 of the QAPP. The DQOs for the investigation of the Base Gas Station will include both screening with definitive confirmation and definitive data. Screening will be used to select data points. Definitive data will be collected to determine the level of fuel-related contamination in soil and groundwater. This was established to characterize the extent of any soil and groundwater fuels contamination at the former tank location; characterize the background and downgradient fuel contaminant levels in groundwater; determine if there has been fuel contaminant migration between the Base Gas Station and the Base Service Station; determine if utility lines are acting as conduits for lateral migration of contaminants from the Base Gas Station, and document and characterize any seepage of fuels into the West Fork of the Trinity River.

The number of samples and their location have been established to detect the presence of fuel-related contaminants and their concentrations at locations and depths at the Base Gas Station and between the Base Gas Station and the Base Service Station. Field screening of data is of adequate quality for determining the exact location for samples to be analyzed by the laboratory. This will enable analyses to be completed that will characterize the vertical and lateral extent of contamination. Laboratory versus field data will be used because it is these data that are defensible and can be used in establishing a remedial action plan.

Monitoring well placement has been established so that wells will be upgradient and downgradient of the Base Gas Station and spaced at intervals to allow the lateral extent of a plume to be determined. Laboratory data will be used in order to provide a reliable basis for the Remedial Action Plan. Field data will be collected on certain parameters to determine if natural attenuation is a viable remedial action alternative.

The number and location of the surface water sample locations were established to permit the comparison of contaminant concentrations so that the source location and volume can be estimated. This will permit projection of the origin of the fuel source and a determination if it originates from the Base Gas Station area.

Site maps showing the locations and types of sampling are included in Section 3.3.1

3.2 Sample Analysis Summary

The summary of the samples that will be collected and analyzed to obtain the data specified in the preceding section is shown in Table 3-1.

3.3 Field Activities

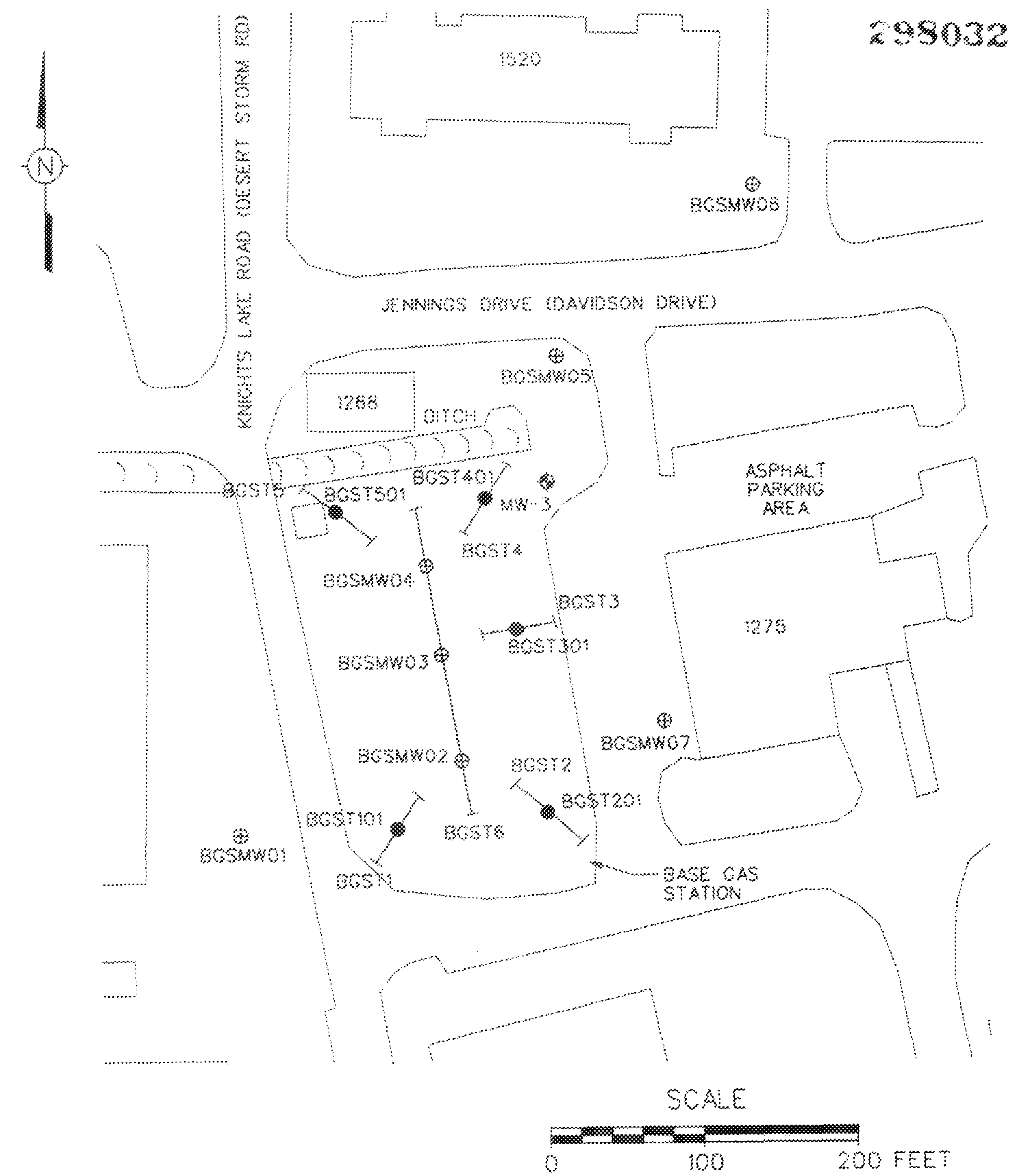
Table 3-2 summarizes the field activities that will be completed during the investigation at the Base Gas Station.

3.3.1 Soil Coring, Soil Boring, and Monitoring Well Locations

Soil corings will be installed along transects BGST1 through BGST5 (Figure 3-1), by Geoprobe® soil probe method, and sampled to the top of the saturated zone. Soil borings will be located at seven locations (BGSMW01 through BGSMW07) as shown in Figure 3-1 and drilled with an auger rig to refusal (top of Walnut formation). Each boring will be continuously sampled and samples will be retained for analysis from the saturated zone and at the depth with the highest indication of contaminants (photoionization detector [PID] readings, visual staining). Two samples will be collected from each borehole. They will then be installed as monitoring wells (Figure 3-1).

Coring locations BGST101, BGST201, BGST301, BGST401, and BGST501, from which samples will be taken for analysis, will be along transects BGST1 through BGST5. They are positioned at the periphery of the tank area and will measure the extent of lateral contamination. The initial starting point for coring at each transect will be at the point that is furthermost along the transect lines shown in Figure 3-1. Field screening will then be used to determine if there is a presence of contamination at the location. If there is none the next coring will be completed closer to the center of the Base Gas Station area. The exact position will be field determined but usually be no more than 25 feet from the initial coring. If contamination is detected by field screening the next coring will be located further away. The exact locations for laboratory sample

298032



LEGEND:

- ⊕ NEW WELL
- ● NEW CORING
- ◈ EXISTING WELL
- ├──┤ SOIL PROBE TRANSECTS

FIGURE 3-1
LOCATION OF CORINGS AND MONITORING WELLS AT BASE GAS STATION

NAVAL AIR STATION FORT WORTH
FORT WORTH, TEXAS

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 3/19/96	DATE LAST REV.:	DRAFT. CHCK. BY: C.TUMLIN	INITIATOR: W.CARTER	DWG. NO.: 765725E5.002
DRAWN BY: K.BLAIR	DRAWN BY:	ENGR. CHCK. BY: W.CARTER	PROJ. MGR.: W.CARTER	PROJ. NO.: 765725

765725E5.002 09:39:42 Jun 26, 1996 RMK

Table 3-1

Summary Table of All Samples
Base Gas Station Field Sampling Plan
NAS Fort Worth
Project No. 765725

Num Fi San | Fi Dup

[1] Field blanks only collected during groundwater and surface water sample events.
[2] Waste analysis sampling includes VOA, TPH, Lead for one solid and 1 water sample.
[3] Refer to Table 8-5 for field sampling test and method table.
[4] Refer to Table 8-6 for geotechnical analysis.
[5] Refer to Table 8-7 for bio parameters.

P:\PROJECTS\AFCEE\CAFB32\FSP\TBL3-1\7/8/96(3:40 pm)

F1/NE

298033

298034

Table 3-2

Field Activities Summary
Base Gas Station Field Sampling Plan
NAS Fort Worth
Project No. 765725

Site	Activity	Number
BGS	Soil Borings (See Note 1 & 2) Fig. 3-1	7
BGS	Soil Probes (Line1) Fig. 3-3	4
BGS	Soil Probes (Line2) Fig. 3-3	3
BGS	Soil Probes (Line 3) Fig. 3-3	6
BGS	Soil Probes (Line 4) Fig. 3-3	3
BGS	Soil Probes (Line 5) Fig. 3-3	4
BGS	Soil Probes (Transect 7 Fig. 3-3	10
BGS	Monitoring Wells Fig. 3-1	7
BGS	Soil Probe Corings (2-4 per transect) at 5 locations	12-24
BGS	Surface Water Sample (Figure 3-5)	4

Note:

(1) All seven will be converted to monitoring wells.

(2) Geotechnical analyses will be taken from BGSMW02 and BGSMW04 boring

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collection will be determined after transects (BGST1, BGST2, etc.) of 2 to 4 corings along each transect have been completed.

One of the boring locations , BGSMW01, will be used to characterize the presumed background conditions. Locations BGSMW02, BGSMW03, and BGSMW04 are near the location of the removed tanks and equipment and are expected to measure the highest levels of soil contamination. Monitoring wells BGSMW02, BGSMW03, and BGSMW04 will be installed in areas of significant soil contamination or LNAPL on Transect 6 (BGST6), spaced "on centers" for future use in remediation. Corings BGST101, BGST201, BGST301, BGST401, and BGST501 represent the coring selected for laboratory analysis of field samples. The specific core selected will be based on field screening data and will be the "uncontaminated" (as determined by field data) coring nearest the former tank locations.

BGSMW07 is positioned east of the former tank location and will measure migration in the downgradient direction. BGSMW05 and BGSMW06 are located to intercept contaminants migrating toward the Base Service Station. These locations will be used, in conjunction with the horizontal conduit investigation, to assess if contaminants from the Base Gas Station are migrating toward the Base Service Station, whether via a natural or man-made pathway.

All soil samples will be analyzed for BTEX, TPH, and PAH, as called for by the TNRCC "Guidance for Risk-Based Assessments at LPST Sites in Texas" (TNRCC, 1995), and also for lead due to the possible storage of leaded fuels. The guidance calls for BTEX and TPH analyses at gasoline sites and BTEX, PAH, and TPH analyses at diesel; jet fuels; and Nos. 1, 2, and 4 fuel oils. VOCs will be continuously monitored in the borehole with a PID.

Two of the soil borings for monitoring wells at the Base Gas Station, BGSMW02 and BGSMW04, will also be used to obtain geotechnical data in support of remedial design. These borings are planned for the area of greatest fuel contamination. Samples from these borings will be analyzed for dry bulk density, effective porosity, fraction organic carbon, intrinsic permeability, and water content, in addition to the chemical analyses.

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3.3.2 Horizontal Conduit Assessment

There are five utility lines that are planned for investigation. The lines, shown on Figure 3-2, are:

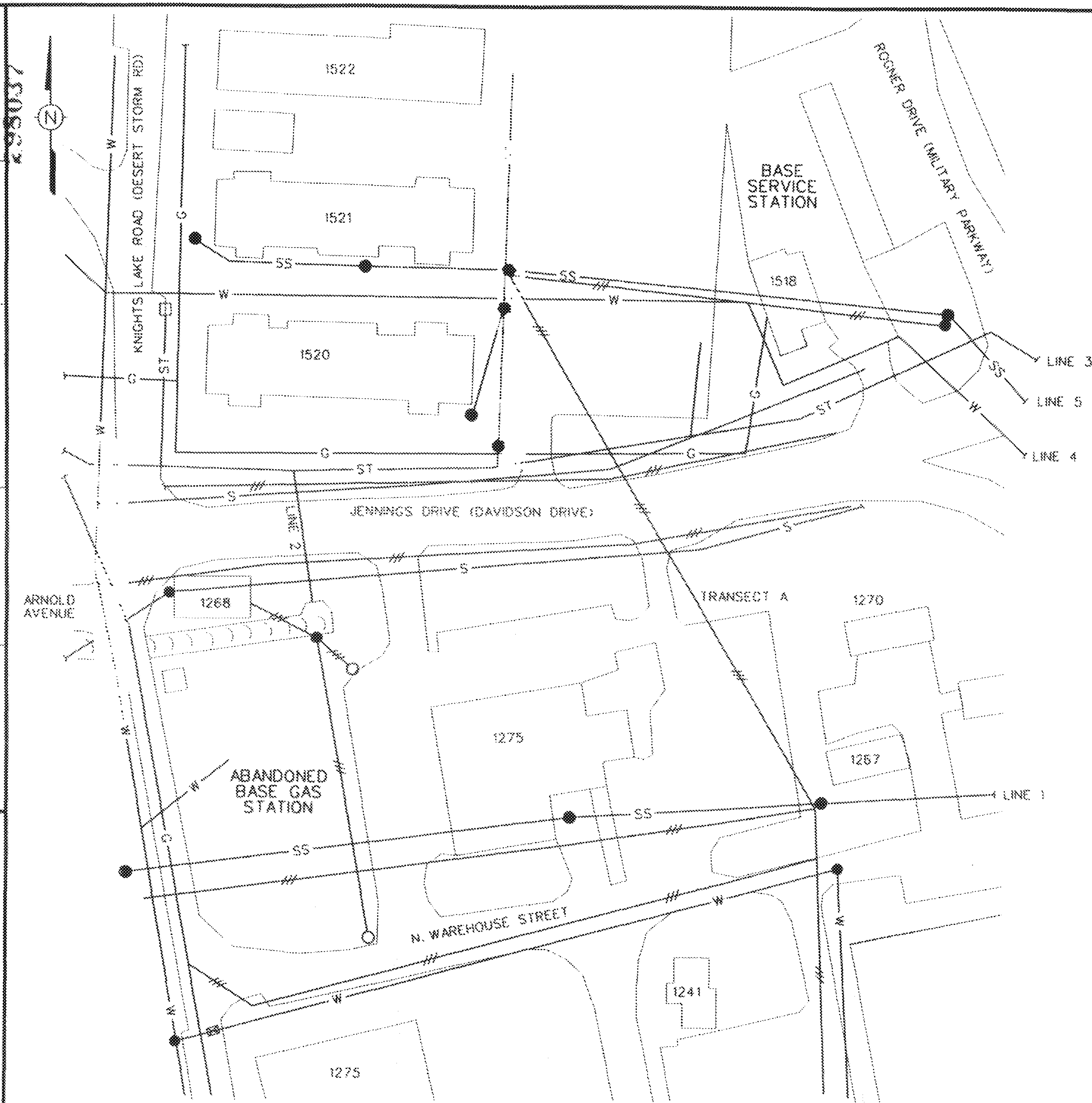
- Line 1: 12-inch sanitary sewer line that drains from west to east along south portion of site.
- Line 2: 24-inch concrete culvert that drains ditch on north portion of site into Line 3.
- Line 3: 5-foot by 4-foot storm sewer of unknown construction, that drains from west to east across Jennings Drive from the site.
- Line 4: 8-inch water supply line, that runs east-west north of Line 3.
- Line 5: Sanitary sewer of unknown size, that drains from west to east just north of Line 4.

After the utility lines have been "cleared" and staked approximately 30 soil cores will be collected along five utility lines (Lines 1 - 5) and Transect 7 (Figure 3-3) to determine if the utility lines are acting as a horizontal conduit to contaminant migration or if a natural conduit exists between the Base Gas Station and the Base Service Station. A Geoprobe® soil probe rig will be used to collect the continuous cores from the surface to the estimated invert elevation of the sewer or other utility line. The probes will be located as close to the buried lines as possible without unreasonable risk of puncturing the line as determined by the accuracy of the utility line field location.

Sample locations are shown on Figure 3-3. Generally, the locations are positioned 100 feet apart, although closer spacing is planned at the junction of Lines 2 and 3. The first samples on Lines 1 (L101) and 3 (L301) are positioned to assess the presence of fuels that may be introduced from elsewhere (upgradient) on the line.

Transect 7 is positioned to cross any east-west trending, naturally occurring transmissive zones such as gravel beds. Soil cores along Transect 7 are spaced approximately 25 feet apart and cores will be collected to bedrock (refusal). The objective of these samples is to determine if

STARTING DATE: 4/15/96	DATE LAST REV	DRAFT CHCK BY: C.TUMLIN	INITIATOR W.CARTER	DWG NO 765725E5.018
DRAWN BY K.BLAIR	DRAWN BY	ENGR CHCK BY W.CARTER	PROJ MGR W.CARTER	PROJ NO 765725



LEGEND:

- —W— WATER
- —G— GAS
- —S— UNDERGROUND ELECTRIC LINE
- —SS— SANITARY SEWER
- —ST— STORM DRAIN
- —///— POWER LINE (OVERHEAD)
- OPEN DRAINAGE
- ○ MANHOLE
- LINE * GEOPROBE SAMPLE LINES
- ( ) NEW NAVY STREET DESIGNATIONS
- ● POWER POLE
- ⊠ WATER VALVE

SOURCE:

COMPREHENSIVE PLAN, COMPOSITE UTILITY SYSTEM, CARSWELL AIR FORCE BASE, G-11; SHEET 15 OF 22 (30 OCT 89 UPDATE)

SCALE

0 100 200 FEET

FIGURE 3-2
UTILITY LINE LAYOUT IN AREA OF BASE GAS STATION AND BASE SERVICE STATION

NAVAL AIR STATION FORT WORTH
FORT WORTH, TEXAS

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DRAWN BY: K.BLAIR	DRAWN BY:	ENGR. CHCK. BY: W.CARTER	PROJ. MGR W.CARTER	PROJ. NO. 765725

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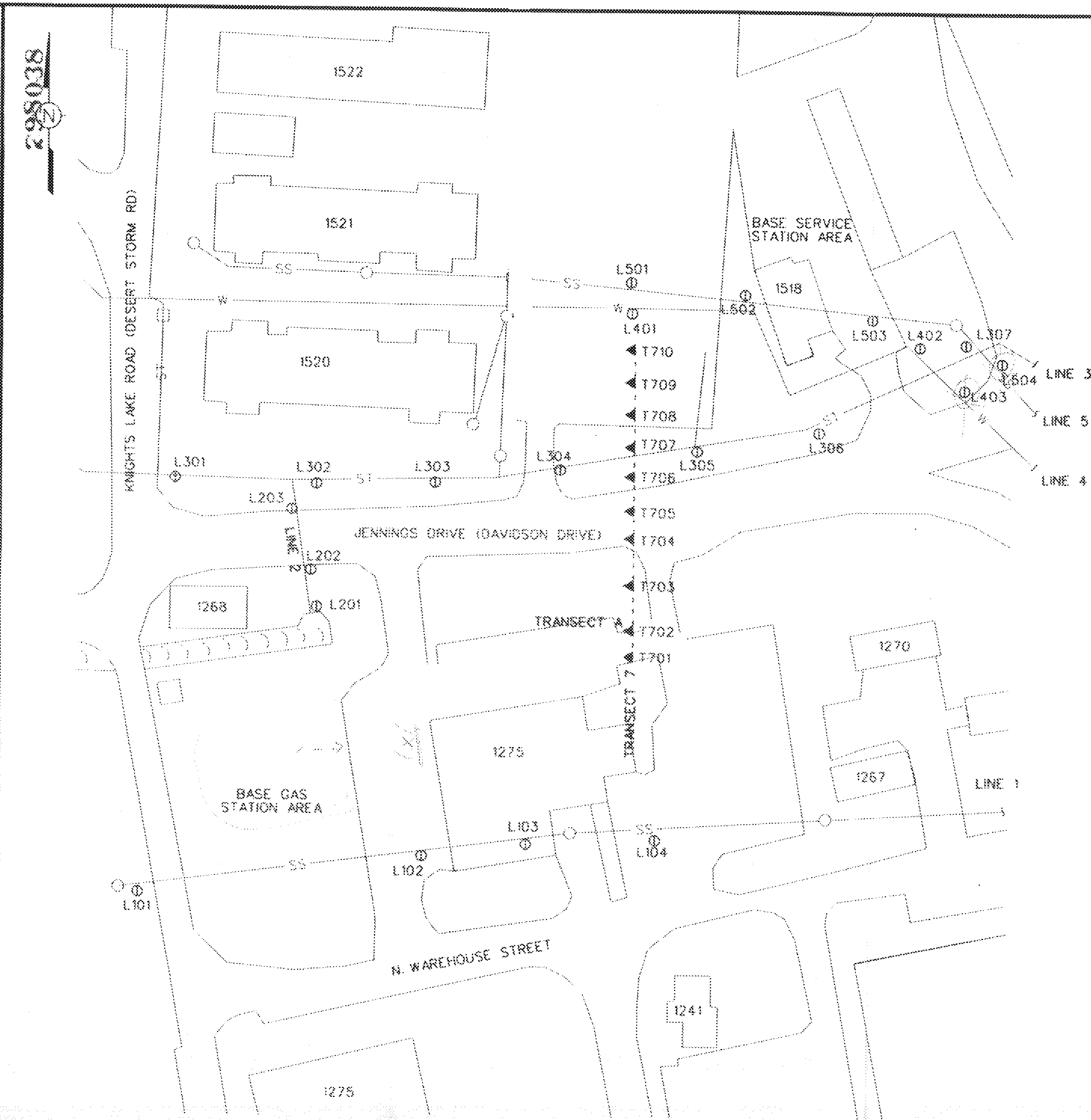

LEGEND:

—W—	WATER
—SS—	SANITARY SEWER
—ST—	STORM DRAIN
	OPEN DRAINAGE
○	MANHOLE
LINE •	SOIL PROBE SAMPLE LINES
⦶	SOIL PROBE POINT
( )	NEW NAVY STREET DESIGNATIONS
▲	TRANSECT 7 PROBE LOCATIONS
●	POWER POLE

NOTE:

1. THE PREFIX "BGS" IS NOT INCLUDED IN THE SOIL PROBE POINT NUMBERS TO SIMPLIFY FIGURE.

SCALE

0 100 200 FEET

FIGURE 3-3
HORIZONTAL CONDUIT
SOIL PROBE LOCATIONS

NAVAL AIR STATION FORT WORTH
FORT WORTH, TEXAS

INTERNATIONAL TECHNOLOGY CORPORATION

such a natural pathway exists between the Base Gas Station and the Base Service Station by examining the lithology.

The investigation plan is based on utility plans because as-built drawings are not available. The lines and coring locations will be confirmed in the field. Base personnel will clear all of the coring locations with regard to known utilities and other obstructions. IT will further clear the locations for buried electrical utility lines.

Other utility lines in the area (e.g., underground electrical conduits and gas lines) are believed to be above the west saturated zone and are not likely to be of significant diameter (6 inches or less). Accordingly, they are presumed to not be a potential horizontal pathway of any significance and will not be investigated.

3.3.3 Surface Water

The West Fork of the Trinity River will be sampled soon after a rain event if fuel seepage into the river is observed in the river downgradient of the Base Gas Station and Base Service Station. Such a discharge would be evidenced by a visible sheen on the water surface. The approximate location of the previous sheen is shown on Figure 3-4. It is assumed that any additional seepage would also be located in that area. If no sheen is observed, no sampling will occur and the river will again be monitored during the next rain event for a evidence of fuel seepage.

Four samples will be collected, all from the bank as shown on Figure 3-5. One sample will be collected well upstream of the sheen to define background conditions; one sample will be collected at the apparent origin of the sheen to define the highest contaminant concentrations; one sample will be taken just within the downstream edge of the sheen to determine the area of the plume; and the last sample will be collected either at the far bank or just outside the downstream edge of the sheen, depending on the configuration of the sheen, to further define the area of the plume. All samples will be collected at the water surface.

STARTING DATE 4/12/96	DATE LAST REV.	DRAFT. CHCK. BY: C.TUMLIN	INITIATOR: W.CARTER	DWG. NO. 765725ES.013
DRAWN BY: K.BLAIR	DRAWN BY:	ENGR. CHCK. BY: W.CARTER	PROJ. MGR.: W.CARTER	PROJ. NO.: 765725

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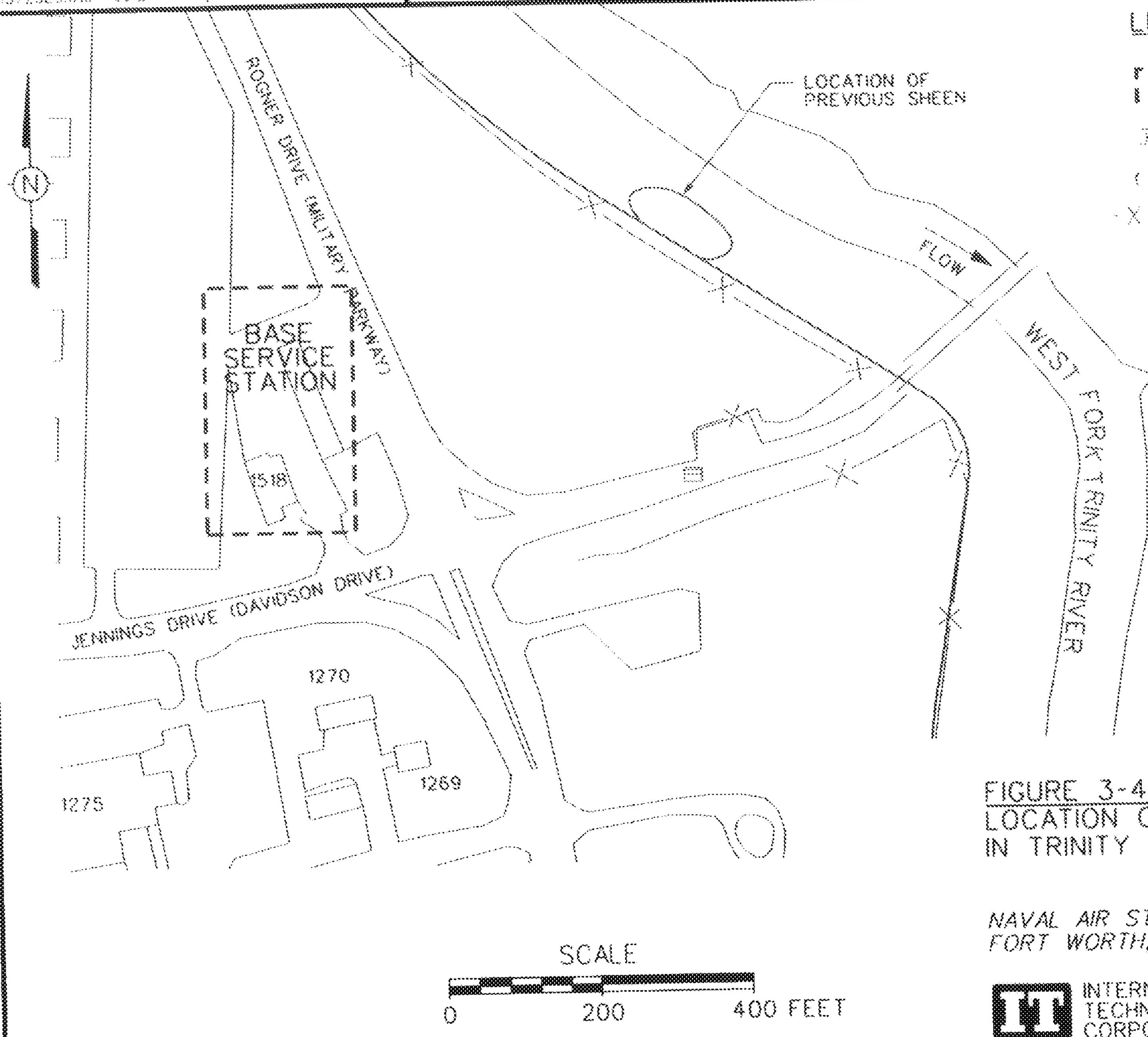

LEGEND:

SITES TO BE INVESTIGATED

OPEN, DRAINAGE DITCH

( ) NEW NAVY STREET NAME

-X—X- INSTALLATION BOUNDARY

FIGURE 3-4
LOCATION OF PREVIOUS SHEEN
IN TRINITY RIVER

NAVAL AIR STATION FORT WORTH
FORT WORTH, TEXAS

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STARTING DATE: 3/20/96	DATE LAST REV.:	DRAFT. CHCK BY: C.TUMLIN	INITIATOR: W.CARTER	DWG. NO. 765725ES.006
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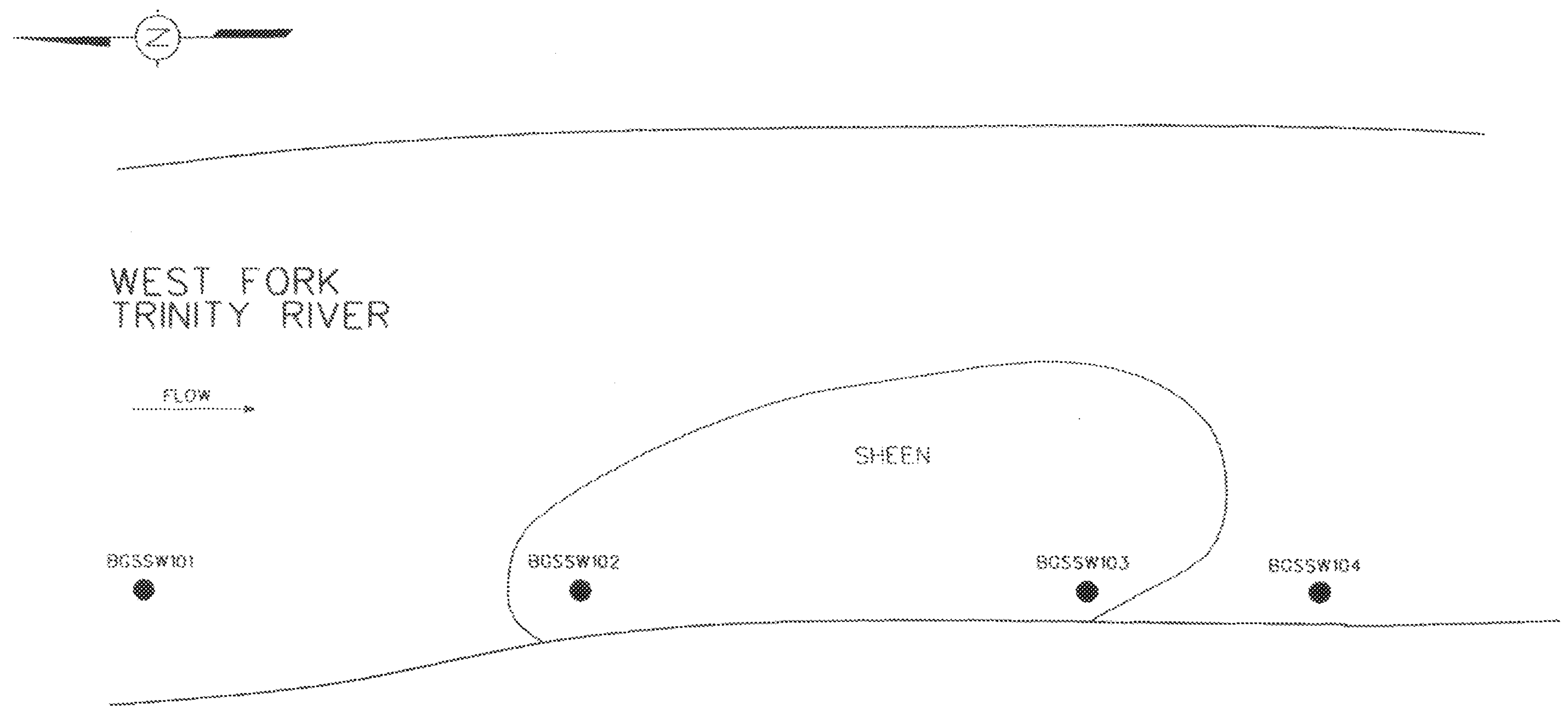

NOTES:

1. EXACT SAMPLE POINT TO BE FIELD DETERMINED.
2. SAMPLING WILL BE DONE WHEN AND WHERE SHEEN APPEARS.
3. REFERENCE FIG. 3-4 FOR RELATIVE LOCATION.

SCALE: NTS

FIGURE 3-5
SURFACE WATER
SAMPLING LAYOUT
BASE GAS STATION

NAVAL AIR STATION FORT WORTH
FORT WORTH, TEXAS

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CORPORATION

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3.4 Sampling Frequency and Analyses

3.4.1 Soils

Soil samples from the immediate vicinity of the Base Gas Station (Figure 3-1) will be used to characterize the site. These soil cores and borings will be screened in the field with a PID and visually examined by the Field Geologist for indications of contaminations (e.g., discoloration). Two samples from each core or boring, one from the top of the saturated zone and one from the zone with the greatest apparent contamination based on the field screening, will be submitted for laboratory analysis. These soil samples will be analyzed for BTEX, TPH, and polycyclic aromatic hydrocarbons (PAH), as called for by the TNRCC *Guidance for Risk-Based Assessments at LPST Sites in Texas* (TNRCC, 1995), and also for lead due to the storage of leaded fuels at the site. The sample soil objectives and analyses are summarized in Table 3-3.

Two of the soil borings for monitoring wells at the Base Gas Station, BGSMW02 and BGSMW04, will also be used to obtain geotechnical data to support remedial design. These borings are planned for the area of greatest fuel contamination. Soil samples from these borings will be analyzed for dry bulk density, effective porosity, fraction organic carbon, intrinsic permeability, and water content, in addition to the chemical analyses.

The samples collected along utility lines as part of the horizontal conduit assessment will be used to assess whether or not utility lines provide a preferential pathway for the fuels. The cores will be screened in the field in the same manner as the site soil probe samples. One sample from the utility line invert elevation and one sample from the depth of highest apparent concentration will be submitted for laboratory analysis. Those samples will be analyzed for BTEX and TPH.

Samples will not be submitted for laboratory analysis from Transect 7, which is designed to identify lithology as discussed in Section 3.3.2, unless contaminants are detected in the field screening. Up to two samples would then be taken, as determined in the field and submitted for analyses of BTEX and TPH.

3.4.2 Groundwater

Groundwater samples will be used to assess the migration of site contaminants, provide chemical data for risk assessment, and to provide data for remedial design. The wells will be sampled

Table 3-3
Sampling Objectives and Analyses for Soil Samples at the Base Gas Station
NAS Fort Worth, Carswell Field, Texas
Project No. 765725

Location	Objective	Lab Analyses[a]	Field Analyses[b]
On-Site Cores[c]			
BGST101	Lateral extent of contaminant migration	BTEX, TPH, PAH, Pb	VOC, visual
BGST201	Lateral extent of contaminant migration	BTEX, TPH, PAH, Pb	VOC, visual
BGST301	Lateral extent of contaminant migration	BTEX, TPH, PAH, Pb	VOC, visual
BGST401	Lateral extent of contaminant migration	BTEX, TPH, PAH, Pb	VOC, visual
BGST501	Lateral extent of contaminant migration	BTEX, TPH, PAH, Pb	VOC, visual
Well Borings[c]			
BGSMW01	Background characterization	BTEX, TPH, PAH, Pb, NH_4, PO_4, TKN, % H_2O, pH	VOC, visual, O_2, CO_2, CH_4
BGSMW02	Characterization of tank location, product recovery	BTEX, TPH, PAH, Pb, bulk density, porosity, organic carbon, permeability, water content, NH_4, PO_4, TKN, % H_2O, pH	VOC, visual, O_2, CO_2, CH_4
BGSMW03	Characterization of tank location, product recovery	BTEX, TPH, PAH, Pb	VOC, visual
BGSMW04	Characterization of tank location, product recovery	BTEX, TPH, PAH, Pb, bulk density, porosity, organic carbon permeability, water content, NH_4, PO_4, TKN, % H_2O, pH	VOC, visual, O_2, CO_2, CH_4
BGSMW05	Extent of contaminant migration toward Base Service Station	BTEX, TPH, PAH, Pb	VOC, visual

Table 3-3
Sampling Objectives and Analyses for Soil Samples at the Base Gas Station
NAS Fort Worth, Carswell Field, Texas
Project No. 765725

Location	Objective	Lab Analyses[a]	Field Analyses[b]
Well Borings[c]			
BGSMW-6	Extent of contaminant migration toward Base Service Station	BTEX, TPH, PAH, Pb	VOC, visual
BGSMW-7	Extent of downgradient migration	BTEX, TPH, PAH, Pb, NH_4, PO_4, TKN, % H_2O, pH	VOC., visual O_2, CO_2, CH_4
Horizontal Conduit			
Line 1[d]:			
BGSL101	Background on Line 1	BTEX, TPH, Pb	VOC, visual
BGSL102	Downgradient on Line 1	BTEX, TPH, Pb	VOC, visual
BGSL103	Downgradient on Line 1	BTEX, TPH, Pb	VOC, visual
BGSL104	Downgradient on Line 1	BTEX, TPH, Pb	VOC, visual
Line 2[d]:			
BGSL201	Entrance to culvert	BTEX, TPH, Pb	VOC, visual
BGSL202	After crossing Jennings Road	BTEX, TPH, Pb	VOC, visual
BGSL203	Before joining Line 3	BTEX, TPH, Pb	VOC, visual
Line 3[d]:			
BGSL301	Background on Line 3	BTEX, TPH, Pb	VOC, visual
BGSL302	After receiving inlet from Line 2	BTEX, TPH, Pb	VOC, visual
BGSL303	Downgradient on Line 3	BTEX, TPH, Pb	VOC, visual
BGSL304	Downgradient on Line 3	BTEX, TPH, Pb	VOC, visual

Table 3-3
Sampling Objectives and Analyses for Soil Samples at the Base Gas Station
NAS Fort Worth, Carswell Field, Texas
Project No. 765725

Location	Objective	Lab Analyses[a]	Field Analyses[b]
BGSL305	Monitors both Line 3 and Line 5	BTEX, TPH, Pb	VOC, visual
BGSL306	Downgradient on Line 3	BTEX, TPH, Pb	VOC, visual
BGSL307	Downgradient on Line 3	BTEX, TPH, Pb	VOC, visual
Line 4[d]:			
BGSL401	Background on Line 4, probe to bedrock as point on Transect 1	BTEX, TPH, Pb	VOC, visual
BGSL402	Downgradient of Base Service Station	BTEX, TPH, Pb	VOC, visual
BGSL403	Downgradient of Line 4	BTEX, TPH, Pb	VOC, visual
Line 5[d]:			
BGSL501	Background on Line 5, probe to bedrock as point on Transect 1	BTEX, TPH, Pb	VOC, visual
BGSL502	Immediately upgradient of Base Service Station	BTEX, TPH, Pb	VOC, visual
BGSL503	Immediately downgradient of Base Service Station	BTEX, TPH, Pb	VOC, visual
BGSL504	Downgradient of Crossing Line 3	BTEX, TPH, Pb	VOC, visual
Transect 7[e]:			
T701	Lithology (probe to bedrock)		VOC, visual
T702			VOC, visual

Table 3-3
Sampling Objectives and Analyses for Soil Samples at the Base Gas Station
NAS Fort Worth, Carswell Field, Texas
Project No. 765725

Location	Objective	Lab Analyses[a]	Field Analyses[b]
Transect 7[c]:	Lithology (probe to bedrock) (continued)		
T703			VOC, visual
T704			VOC, visual
T705			VOC, visual
T706			VOC, visual
T707			VOC, visual
T708			VOC, visual
T709			VOC, visual
T710			VOC, visual

[a] BTEX = benzene, toluene, ethyl benzene, and xylene
TPH = total petroleum hydrocarbons
PAH = polycyclic aromatic hydrocarbons
Pb = lead from leaded gasoline

[b] VOC = volatile organic hydrocarbons, as measured by a photoionization detector.
[c] Two samples will be collected at each location: at the saturated zone and at the zone of highest apparent contamination.

[d] One sample for lab analysis will be taken from the invert elevation of the utility line and a second sample will be taken from the zone of greatest apparent contamination, if contaminants are noted by field screening.
[e] 0-2 samples will be taken for lab analyses based on results of field screening.

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twice, once after installation and development, and once three months later. If free product is encountered, it will be removed with a downhole LNAPL recovery pump before sampling. The sampling and analyses plan for groundwater sampling is stated in Table 3-4.

Laboratory analysis of the initial groundwater samples will be for BTEX, TPH, methyl tertiary butyl ether (MTBE), total dissolved solids (TDS), and PAH, as called for by the TNRCC "Guidance for Risk-Based Assessments at LPST Sites in Texas" (TNRCC, 1995); for nitrate, sulfate, and methane to facilitate evaluation of intrinsic bioremediation occurring at the site; and for lead due to the possible storage of leaded fuels. Nitrate, sulfate, methane, and TDS analyses are not planned for the second sampling event.

Field analyses will be conducted during the first sampling event for ferrous iron, sulfide, carbon dioxide, dissolved oxygen, redox potential, temperature, conductivity, pH, and total volatiles (as measured by a PID). These analyses are to facilitate evaluation and assessment of the occurrence of natural attenuation and the implementability of in situ bioremediation technologies for the groundwater. Temperature, conductivity, pH, dissolved oxygen, redox potential, and PID readings will be repeated for the second sampling.

3.4.3 Surface Water

Surface water samples will be collected to confirm and characterize an observed fuel release into the Trinity River. The samples will only be collected if a sheen is observed, indicating the possible presence of fuel. One such sampling event is planned. The sampling and analyses for surface water samples is stated in Table 3-5.

The samples will be analyzed for BTEX, TPH, PAHs, and lead. No field analyses will be performed. The sheen will be documented by photographs and field notes depicting the apparent size, appearance, and configuration of the sheen. A search of the bank area for seeps will be conducted and documented in the Field Activity Daily Log (FADL).

Table 3-4
Sampling Objectives, Frequency, and Analyses for Ground Water at the Base Gas Station
NAS Fort Worth, Carswell Field, Texas
Project No.: 765725

Well Location	Objectives	Sampling Frequency
BGSMW01	Characterize background conditions.	Twice: 0, 3 months
BGSMW02	Characterize former tank area, product removal.	Twice: 0, 3 months
BGSMW03	Characterize former tank area, product removal.	Twice: 0, 3 months
BGSMW04	Characterize former tank area, product removal.	Twice: 0, 3 months
BGSMW05	Determine migration toward Base Service Station.	Twice: 0, 3 months
BGSMW06	Determine migration toward Base Service Station	Twice: 0, 3 months
BGSMW07	Determine downgradient migration	Twice: 0, 3 months

Field Analyses (All Wells)		Laboratory Analyses (All Wells)[a]	
1st Sampling	2nd Sampling	1st Sampling	2nd Sampling
Ferrous iron	Total Volatiles (PID)	BTEX	BTEX
Sulfide	pH	TPH	TPH
Carbon dioxide	Temperature	Nitrate	MTBE
Dissolved oxygen	Conductivity	Sulfate	PAH
Redox potential		MTBE	Lead
pH		TDS	
		PAH	
Total Volatiles (PID)		Lead	
Conductivity		Methane	
Temperature		Alkinity	

[a] BTEX = benzene, toluene, ethylbenzene, xylene
TPH = total petroleum hydrocarbon
MTBE = methyl tertiary butyl ether
TDS = total dissolved solids
PAH = polycyclic aromatic hydrocarbons

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Table 3-5
Sampling Objectives, Frequency, and Analyses for Surface Water near the Base Gas Station
NAS Fort Worth, Carswell Field, Texas
Project No.: 765725

Sample Location	Objectives	Frequency	Analyses[a]
BGSSW01	Characterize background (upstream).	Once	BTEX, TPH, PAH, Pb
BGSSW02	Characterize highest plume concentration	Once	BTEX, TPH, PAH, Pb
BGSSW03	Determine plume boundary.	Once	BTEX, TPH, PAH, Pb
BGSSW04	Determine plume boundary.	Once	BTEX, TPH, PAH, Pb

[a] BTEX = benzene, toluene, ethylbenzene, xylene
TPH = total petroleum hydrocarbon
PAH = polycyclic aromatic hydrocarbons
Pb = lead

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TAB

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4.0 Project Organization and Responsibility

The Project Organization is established as shown in Figure 4-1. Responsibilities of the key individuals are as specified in Section 3.0 of the QAPP.

Subcontractors. Subcontracts will be executed under this project for borehole and monitoring well installation, installation of soil probes, analytical laboratory testing, and surveying. These have not been executed as of the issuance of this FSP but as they are these will be communicated to the parties affected by their performance. The key personnel within each subcontractor's organization will be identified.

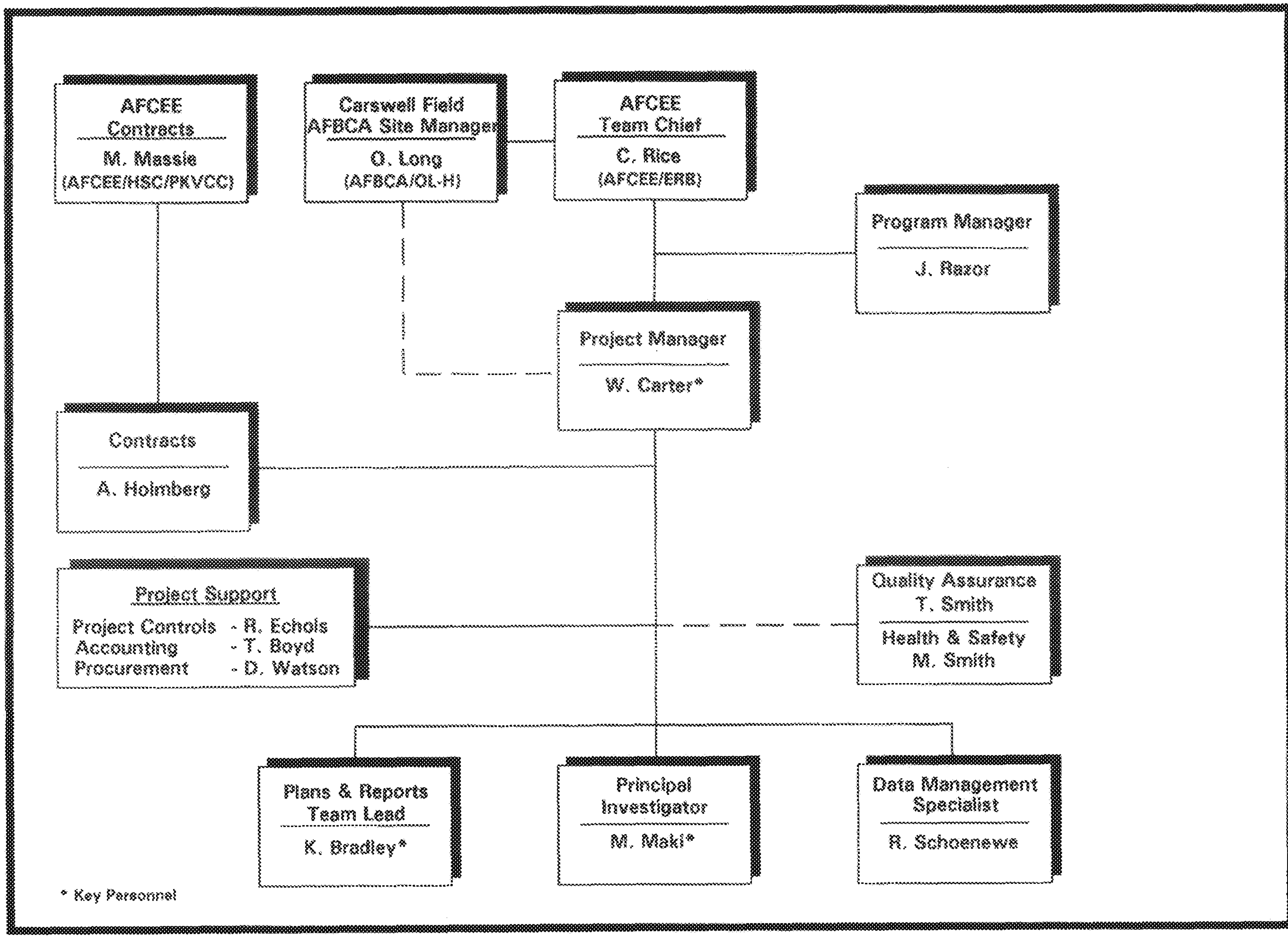

Figure 4-1. Project Organization
NAS Fort Worth
765725

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TAB

5.0

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5.0 Field Operations

Chapter 3.0 includes figures for all field investigations; the maps included in this section include the maps with specific investigation locations shown.

5.1 Geologic Standards

The lithologic descriptions for consolidated materials (igneous, metamorphic, and sedimentary rocks) shall follow the standard professional nomenclature (cf. Tennissen, A.C., 1983, *Nature of Earth Materials*, 2nd Edition, p. 204-348), with special attention given to describing fractures, vugs, solution cavities and their fillings or coatings, and any other characteristics affecting permeability. Colors shall be designated by the Munsell Color System.

The lithologic descriptions for unconsolidated materials (soils [engineering usage] or deposits) shall use the name of the predominant particle size (e.g., silt, fine sand, etc.). The dimensions of the predominant and secondary sizes shall be recorded using the metric system. The grain size and name of the deposit shall be accompanied by the predominant mineral content, accessory minerals, color, particle angularity, and any other characteristics. The clastic deposit descriptions shall include, as a supplement, symbols of the Unified Soil Classification System (USCS). The color descriptions shall be designated by the Munsell Color System.

The sedimentary, igneous, and metamorphic rocks and deposits shall be represented graphically by the patterns shown in Figure 5-1. Columnar sections, well and boring logs, well construction diagrams, cross sections, and three-dimensional (3-D) diagrams shall use these patterns. Supplementary patterns shall follow Swanson, R. G., 1981, *Sample Examination Manual*, American Association of Petroleum Geologists, p IV-41 and 43. Geologic structure symbols shall follow *American Geological Institute Data Sheets*, 3d Edition, 1989, Sheets 3.1 through 3.8.

The scales for maps, cross sections, or 3-D diagrams shall be selected in accordance with the geologic and hydrologic complexity of the area and the purposes of the illustrations. Geophysical logs shall be run at a constant vertical scale of 1 inch equals 20 feet. When geophysical logs are

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Sediments and Sedimentary Rocks

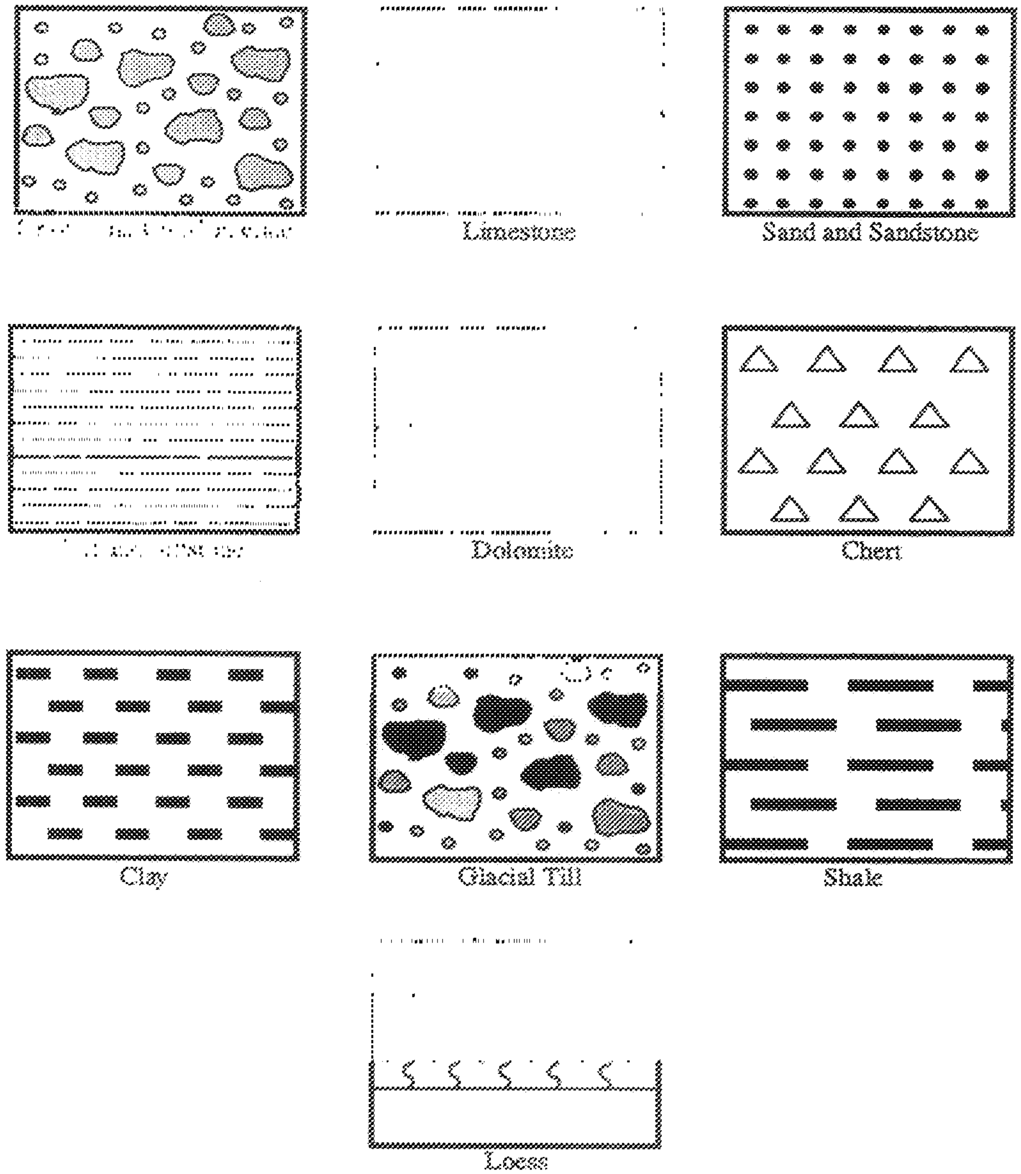

Figure 5-1

Lithologic Patterns for Illustration

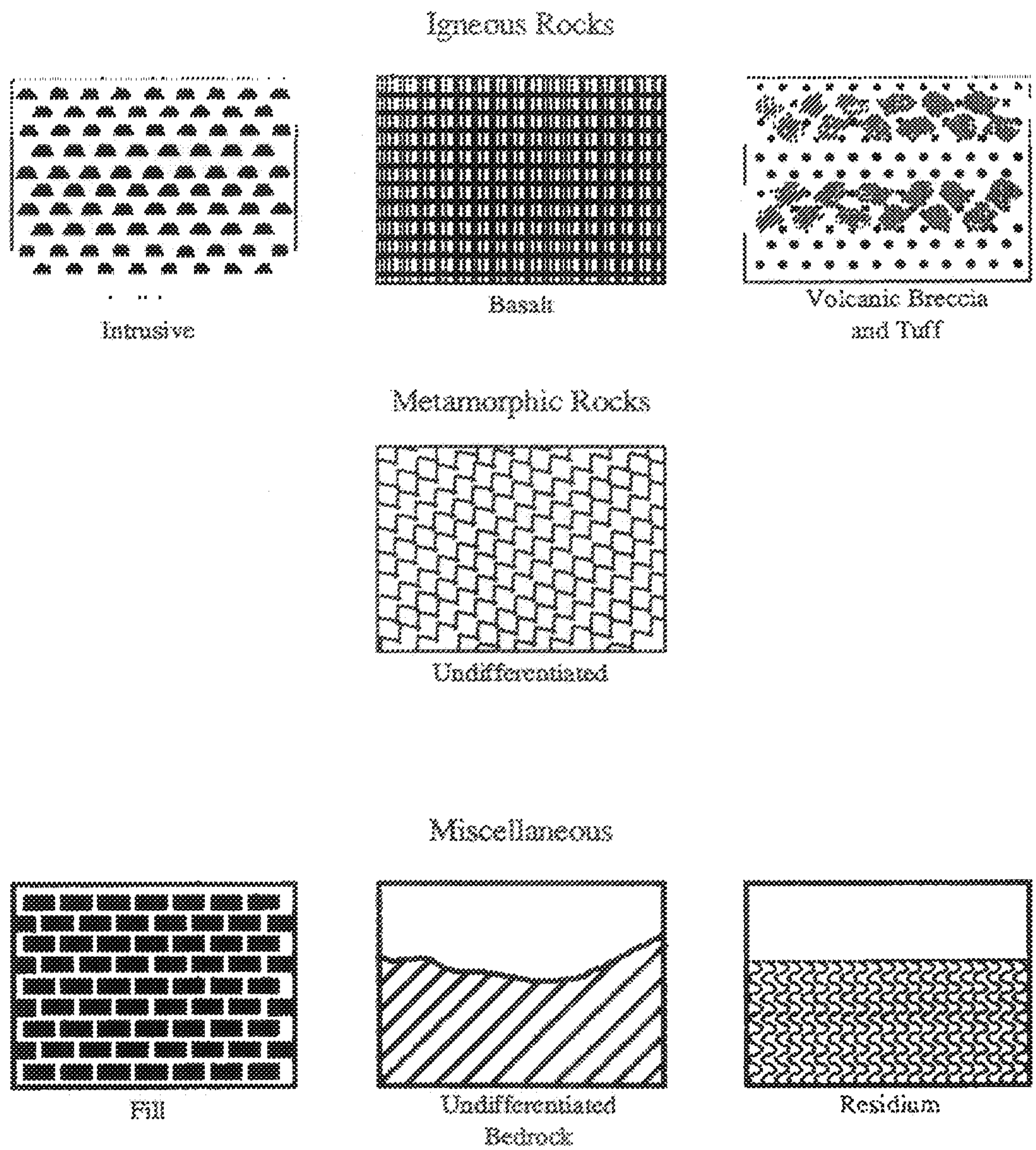

Figure 5-1 (Continued)

Lithologic Patterns for Illustration

superimposed on geologic logs, cross sections, or 3-D diagrams, the scales shall be the same. If defining geological conditions requires other scales, additional logs at those scales shall be provided.

For orientation, the cross sections shall show the Northern end on the viewer's right. If the line of cross section is predominantly East-West, the Eastern end is on the right. Maps shall be oriented with North toward the top, unless the shape of the area dictates otherwise. Indicate orientation with a North arrow.

5.2 Site Reconnaissance, Preparation, and Restoration Procedures

Areas designated for intrusive sampling shall be surveyed for the presence of underground utilities. Utility locations have been determined using existing utility maps. These will be updated in the field, are verified using a hand-held magnetometer or utility probe. Vehicle access routes to sampling locations shall be determined prior to any field activity. Caution tape and barricades will be used to delimit work areas.

A designated decontamination area shall be provided for drilling rigs and equipment. The decontamination area shall be large enough to allow storage of cleaned equipment and materials prior to use, as well as to stage drums of decontamination waste. The decontamination area shall be lined with a heavy gauge plastic sheeting, and designed with a collection system to capture decontamination waters. Solid wastes shall be accumulated in 55-gallon drums and subsequently transported to a waste storage area designated by the Air Force. Smaller decontamination areas for personnel and portable equipment shall be provided as necessary. These locations shall include basins or tubs to capture decontamination fluids, which shall be transferred to a large accumulation tank as necessary. These designated areas of decontamination shall be designated prior to mobilization.

The contractor's field operation office will be established in that area designated by the Air Force, AFBCA, Remedial Project Manager.

Each work site or sampling location shall be returned to its original condition when possible. Efforts shall be made to minimize impacts to work sites and sampling locations, particularly those in or near sensitive environments such as wetlands. Following the completion of work at a

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site, all drums, trash, and other waste shall be removed. Decontamination and/or purge water and soil cuttings shall be transported to the designated locations as described in Section 5.12.

5.3 Geophysical Surveys

None will be performed as part of this investigation.

5.4 Soil Gas Surveys

None will be performed as part of this investigation.

5.5 Borehole Drilling, Lithologic Sampling, Logging, and Abandonment

5.5.1 Soil Borings

Seven soil borings will be drilled at the Base Gas Station from ground surface to drill bit refusal at the top of the Walnut Formation (Figure 3-1) at locations BGSMW01 through BGSMW07. Exact locations will be determined in the field based on site conditions at the time of drilling and on soil probe field screening results. Borings will be drilled using a 6-inch diameter hollow-stem auger. Borings will be drilled from ground surface to auger refusal, which is expected to be the top of the Walnut Formation at an estimated depth of 20 feet. Soil samples will be collected with a California modified style spilt spoon. Soil samples will be collected in three 6-inch long brass sleeves contained with the spilt spoon. The sampler will be retrieved with the drill rods it is attached to from the auger after the interval is drilled. As soon as the split barrel is opened, the gaps between the brass sleeves shall be monitored for organic vapors using a PID. Air monitoring results shall be recorded on the boring log and in the Field Activity Daily Log. Soil chemistry samples will be selected from the brass sleeves exhibiting the highest PID readings. The two laboratory cleaned brass sleeves with the soil samples selected for laboratory analysis will be sealed with Teflon ® tape and either a vinyl or polyethylene cap. The third sleeve will be used to classify the soils and monitor headspace vapors.

The drill rig will be sampled continuously by a qualified geologist. The drill rig will be decontaminated prior to drilling and any part that will contact a sample between boreholes. The geologist will classify the soil by ASTM methods including soil type, color, moisture, firmness, and note other soil characteristics such as staining. Additional information recorded on the bore hole log will be soil sampling location, the method of sampling, the percent recovery of the sample, the depth to first water encountered, and the results of field screening. All hand soil sampling tools will be decontaminated between each use.

Field screening will be accomplished by use of a PID measuring headspace vapors of selected portions of the soil sample. Soil samples will be placed in a sealable plastic bag with boring number, depth, and time marked on it, and allowing the bagged sample to adjust to ambient surface temperature. Headspace concentrations in the plastic bag will be checked by puncturing the bag with a PID probe, measuring the headspace concentration in the bag and recording the PID reading and time on the borehole log.

Based on field screening, using both field measurement instruments and visual observation, two soil samples from each boring will be selected for laboratory analysis. The seven borings will be converted into monitoring wells. Monitoring well construction methods are described in Section 5.6. Any boring that is not converted to a monitoring well will be grouted from total depth to the surface.

5.5.2 Soil Probe Corings

Subsurface assessment of soil at the Base Gas Station will be performed with soil probe methods to define the vertical and horizontal extent of petroleum impacted soils. The Base Gas Station soil assessment will be performed with a sequence of five soil probe transects located at the perimeter of the former Base Gas Station tank farm, as shown on Figure 3-1 and discussed in Section 3.3.1.

Horizontal conduit investigation and Base Gas Station soil assessment borings will be performed by soil probe methods, using decontaminated Geoprobe® or equivalent equipment. Either a large bore (1.0625-inch inside diameter [ID]) or Maccro-core® (1.5-inch ID) soil sampler will be used with a polyethylene terephthalate (PET) or cellulose acetate butyrate (CAB) liner in the sample tube.

Soil probes will be advanced and samples collected continuously from the surface to a depth of about 20 feet or to probe refusal at bedrock. The soil probe unit consists of a truck mounted hydraulic driven soil probe with steel probe rods, and assorted sampling equipment. A hydraulically driven hammer drill will penetrate paved or hard surfaces before continuous sampling begins. All parts of the soil probe assembly that contact seals will be decontaminated between each use.

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The soil sample device has a retractable drive point that will allow driving the sampler to the selected depth, releasing the drive point, and then driving the sampling tube across the selected soil simple interval. The probe unit then retracts the soil sampler to the surface where the soil sample is extracted from the sampling tube. The soil sample will be encased in a clear PET or CAB liner that will allow visual classification of the soil and collection of soil samples by the field geologist. The sleeve containing the selected soil sample will be capped with Teflon tape and slip-on end caps. The ends of the capped sleeve will also be wrapped with Teflon tape. Care will be taken not to touch the ends of the sleeves before capping.

The geologist will maintain detailed boring logs in conformance with standard operating procedures outlined in the QAPP. The boring logs will record material classifications, sample locations and descriptions, PID field screening readings, groundwater encountered, and other observations.

Completed soil probe borings will be abandoned by: filling the boring with bentonite chips placed from total depth to the surface; tamping the chips in the boring with a rod; and hydrating the chips with potable water. The boring will be reinspected by the field geologist within 24 hours to determine if grouting of the boring is satisfactory and if additional grout materials may be needed. Borings located on paved surfaces will be capped with an asphaltic material plug.

5.5.3 Plugging and Abandonment

Abandonment and grouting of borings will be supervised in the field by a qualified geologist. All borings will be barricaded and covered with a surface plate at all times unless work is being performed on the boring. The plate will entirely cover the opening at the surface to eliminate fall hazards and will prevent entry of foreign objects into the boring. The borehole will be inspected and its depth measured before grouting to check for hole collapse.

The borehole shall be grouted to the surface by placing a cement/bentonite grout mixture into the boring to the ground surface. The components of the grout will be mixed in a clean, aboveground, rigid container with a mechanical paddle device or recirculation with a grout pump. Manual mixing will not be allowed. Mixing activities will continue until a smooth, lump free consistency is achieved. The grout mixture shall be mixed of measured ingredients of 3 to 5 percent (about 5 pounds) of powdered bentonite, one 94-pound sack of Type I portland cement, and approximately 8 gallons of potable water and mixed to a lump free consistency. The grout will weigh between 13 to 14 pounds per gallon and weighed in the field with a mud balance.

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Grout that does not pass this specification will be adjusted or disposed of. A tremmie pipe will be used to pump the grout from the bottom of the boring to the surface if the boring exceeds 20 feet in depth or the boring is caving or bridging after withdrawal of the augers. The grout will be allowed to cure for 24 hours and the boring reinspected for proper grout curing. Additional grout mixture or concrete will be placed as required to bring the surface level with grade if settlement has occurred.

5.6 Monitoring Wells

5.6.1 Installation

The hollow-stem auger method will be used to install the new wells at the Base Gas Station. A soil boring will be enlarged by overreaming then completed as a monitoring well. The inside diameter of the decontaminated overreaming auger shall be at least 8 inches in outside diameter. Figure 5-2 shows a general monitoring well design.

Well screens will be 4-inch inner diameter schedule 40 PVC pipe with a 0.01-inch slot (No. 10) size with a threaded cap below the screen. The well screen will be steam cleaned no more than 24 hours before installation and wrapped in plastic to protect its cleanliness until use. The condition of the well screen will be inspected by the geologist prior to its placement. Connections between the screen and well casing will be flush threaded with no glue used to join casing. A direct measurement of the borehole depth by the use of a weighted tape will be made before screen placement. The depth, to the nearest tenth of a foot, will be recorded on the well construction log. The screen for monitoring wells will cover the full saturated thickness of the water bearing unit, but it will not exceed 10 feet in length. The top of the screened interval will extend a minimum of 3 feet above the top of the saturated interval for future potential remedial uses of the well.

The well casing will be 4-inch ID Schedule 40 PVC blank pipe with threaded connections. The well casing will extend from the top of the screen to approximately ground surface for a flush mount style completion. The top of the well casing will be secured with a well cap to prevent entry of foreign objects during completion (Figure 5-2).

After the screen is placed inside the augers, the filter pack will be placed between the screen and inner wall of the hollow-stem auger. The filter pack is to be placed in the well by tremmie pipe in such a manner as to be distributed around the screen at a uniform height and density. For

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(Not To Scale)

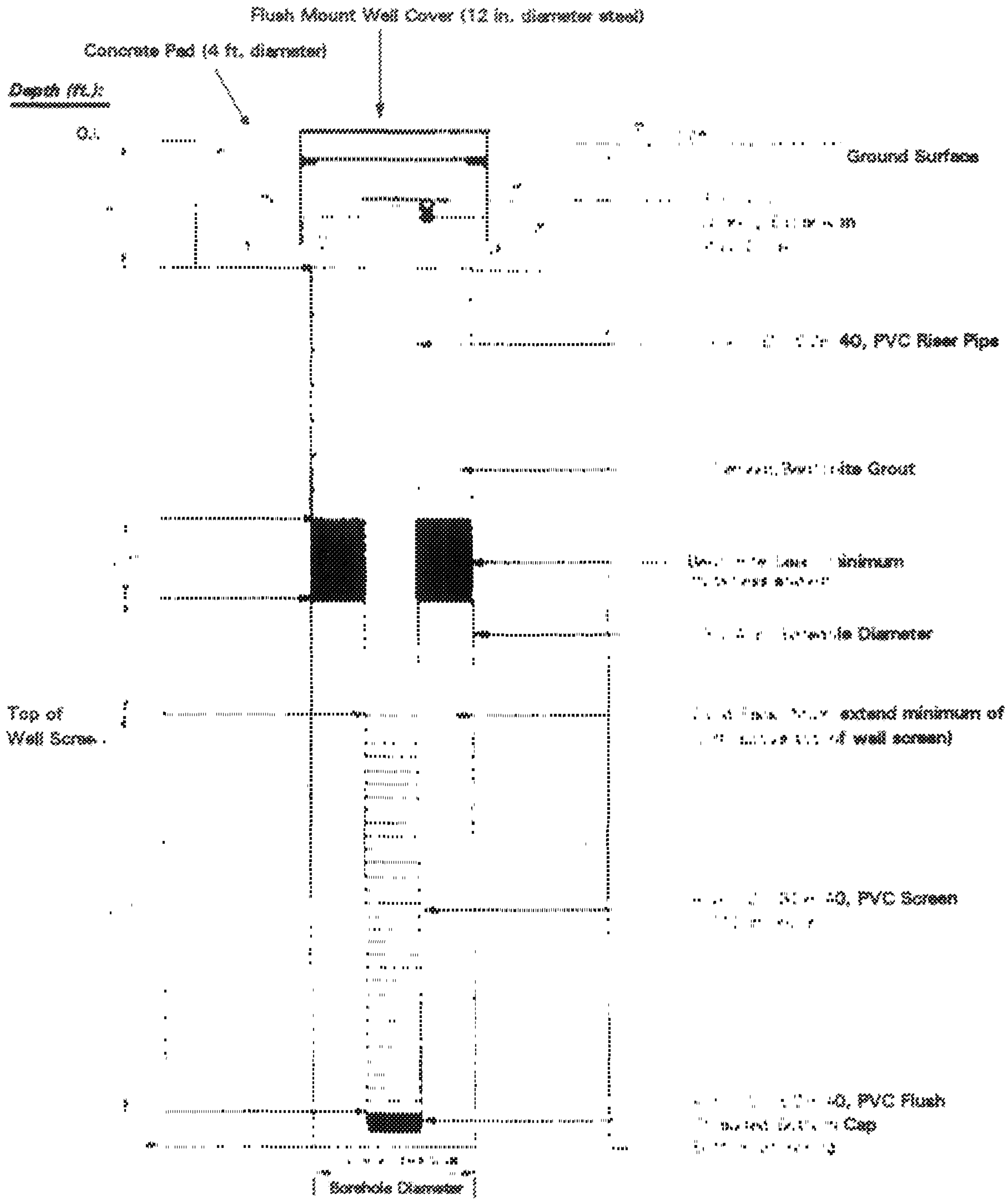

FIGURE 5-2
Monitoring Well Design
prepared for:

NAVAL AIR STATION FORT WORTH
FORT WORTH, TEXAS

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wells with a total depth shallower than 25 feet; however, the filter pack sand may be placed in the annulus between the well screen and the augers as the augers are withdrawn from the boring to allow the filter pack to slump against the side walls of the boring and prevent borehole caving.

The filter pack will extend a minimum of 2 feet and a maximum of 5 feet above the top of the well screen. The filter pack will consist of a washed, rounded 95 plus percent silicious aggregate, and will be free of lignite and chlorides. The filter pack sand for the wells will be 20/40 sized sand. The field geologist will inspect the filter pack prior to placement.

The bentonite seal will consist of at least 2 feet of bentonite above the filter pack and below the grout seal. The well construction will be designed so the bentonite is placed in a nontransmissive zone and effectively isolates the screened interval. The bentonite will be 100 percent sodium bentonite pellets and will be placed on top of the sand pack in the annular space between the well casing and the augers. The augers will be raised to allow the bentonite pellets to slump against the side walls of the boring. After the elevation of the top of the bentonite seal is confirmed by weighted tape, the bentonite pellets will be hydrated with potable water and well activity will cease for 2 hours to allow the bentonite to hydrate. After the hydration period, the top of the bentonite seal will be determined by direct measurement with a weighted tape and recorded on the well construction log.

Cement/bentonite grout will consist of portland cement and powdered sodium bentonite mixed with the same procedures as described in Section 5.5.3. The grout will be pumped until the grout returns to the surface. The level of the grout mixture will be left 1 foot bgs to allow installation of flush mount casing protectors.

Flush mount surface completions will be flush with the land surface if located on a paved surface. The casing protector will be located in the middle of a 4-foot by 4-foot by 4-inch thick concrete pad that slopes away from the casing protector at 1/4 inch per foot. The identity of the well shall be permanently marked on the well cover lid and the casing cap.

5.6.2 Well/Piezometer Completion Diagrams

A completion diagram shall be submitted for each monitoring well or piezometer installed. It shall include the following information: (1) well identification (this shall be identical to the boring identification described), (2) drilling method, (3) installation date(s), (4) elevations of ground surface and the measuring point notch, (5) total boring depth, (6) lengths and descriptions

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of the screen and casing, (7) lengths and descriptions of the filter pack, bentonite seal, casing grout, and any back-filled material, (8) elevation of water surface before and immediately after development, and (9) summary of the material penetrated by the boring.

Forms for these data are in Appendix B of the QAPP.

5.7 Monitoring Well Development

Each well will be developed using a decontaminated submersible pump, bottom discharge/filling bailer or a surge block as soon as practical, but not sooner than 48 hours nor longer than 7 calendar days after placement of the internal cement/bentonite well grout seal. Prior to development, the static water level will be measured from the top of the casing and recorded. During purging, water throughout the entire water column will be removed by periodically raising and lowering the development equipment.

Well development will consist of evacuation of water and surging the well until the groundwater produced is clear and the sediment thickness remaining in the well is less than 1 percent of the screen length. Representative groundwater is presumed to have been obtained when:

- A minimum of five casing volumes of water have been removed from the well.
- The water is clear to the unaided eye and is relatively free of suspended sediments.
- Field measurement of the water for pH is within 0.1 standard unit of the previous reading.
- Field measurement of the water specific conductivity is within 5 percent of the previous reading.
- Field measurement of the water temperature is within 1°C of the previous reading.
- Field measurements will be recorded on the groundwater well development/purge log in Appendix B of the QAPP.

5.8 Abandoning Monitoring Wells

All abandonment of monitoring wells, when directed to do so by the SOW, shall be performed in accordance with state and local laws and regulations. If slurry is used, a mud balance and/or Marsh Funnel shall be used to ensure that the density (pounds per gallon [lbs/gal]) of the abandonment mud mixture conforms with the manufacturer's specification. All abandoned monitoring wells shall be checked 24 to 48 hours after mud/solid bentonite emplacement to determine whether curing is occurring properly. More specific curing specifications or QA checks may be recommended by the manufacturer and shall be followed. Additionally, if significant settling has occurred, a sufficient amount of mud/solid bentonite shall be added to attain its initial level. These slurry/solid bentonite curing checks and any addition of mud/solid bentonite shall be recorded in the field logs.

5.9 Aquifer Tests

No aquifer tests will be performed.

5.10 Test Pit Excavation

There will be no test pits installed.

5.11 Surveying

All surveying locations of field activities shall be measured by a certified land surveyor as the distance in feet from a reference location that is tied to the state plane system. The surveys shall be third order (cf. Urquhart, L.C., *1962 Civil Engineering Handbook*, 4th Edition, p. 96 and 97). An XY-coordinate system shall be used to identify locations. The X-coordinate shall be the East-West axis; the Y-coordinate shall be the North-South axis. The reference location is the origin. All surveyed locations shall be reported using the state plane coordinate system. The surveyed control information for all data collection points shall be recorded and displayed in a table. The table shall give the X and Y coordinates in state plane coordinate values, the ground elevation, and the measuring point elevation if the location is a ground-water monitoring well. The elevation of all newly installed wells and piezometers shall be surveyed at the water level measuring point (notch) on the riser pipe. Include the elevation of the ground surface in the survey.

5.12 Equipment Decontamination

5.12.1 Nonsampling Equipment

A centrally located decontamination station will be established for decontamination of equipment. The decontamination station will include a pad on which the drilling rig, soil probe unit, and other large equipment, such as auger flights, can be steam cleaned. The decontamination pad will be of a temporary construction. The decontamination pad will consist of two layers of minimum 6-mil HDPE plastic sheeting laid out on a level, firm surface. The pad

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edges will be built up with material (lumber or steel) to contain decontamination water. A collection sump will be furnished inside the pad to allow removal of the decontamination waters. Coordination with NAS Ft. Worth personnel will be required to identify the location of the decontamination station. Access to the decontamination station area will be controlled by caution tape, barricades, and warning signs.

The drill rigs and other equipment that could come in contact with the soil being investigated will be steam cleaned between each hole. The general procedures for nonsampling equipment are as follows:

- Drill rigs will be decontaminated before coming onto the Base Gas Station site and before leaving the site.
- Augers, bits, and rods will be decontaminated with high-pressure hot water, scrubbed with phosphate-free detergent, rinsed thoroughly by steam cleaning, and allowed to air dry.
- All casings, screens, and other downhole equipment will be steam-cleaned prior to installation and wrapped in plastic to prevent recontamination.

5.12.2 Sampling Equipment

Field measurement equipment will be kept free of contaminations. All reusable field equipment used to collect, handle, or measure samples shall be decontaminated before coming into contact with any sample. Brushes and soap will be used to remove dirt from equipment that comes into contact with soils.

The decontamination procedures for sampling equipment are as follows:

- Use potable water from a known source with a phosphate-free detergent to wash and brush soil from the sampling item.
- Rinse sampling item thoroughly with potable water, check item for any residual dirt, and rewash if necessary.
- Rinse item with deionized water.
- Rinse item with solvent (methanol) to remove residual organics. Solvents will be pesticide grade or better. Follow with a hexane rinse if fuels are encountered.

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- Allow item to completely air-dry prior to any use. Cover item with uncontaminated plastic if it is not intended for immediate use.

5.13 Waste Handling

The potential waste types generated from work performed during field activities are:

- Drill cuttings and soil samples
- Developments and purge water from well installation and sampling
- Decontamination water
- Personnel protective equipment and decontamination equipment.

Procedures for disposal of these wastes will be coordinated with Base personnel. Analytical testing of these wastes may be required to determine if they are nonhazardous and able to be disposed on site. All decontamination fluid will be collected, contained in an appropriate vessel, properly labeled, and stored on-site at an approved storage facility at the Base. All soils generated during soil borings, well installation, and sampling activities will be collected, contained in drums, properly labeled, and stored on-site until disposal or treatment. All drums will be clearly labeled with the contents, date of accumulation, location generated, and generator.

5.14 Hydrogeological Conceptual Model

Modeling is not part of this project.

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6.0 Environmental Sampling

All purging and sampling equipment shall be decontaminated according to the specifications in Section 5.12 prior to any sampling activities and shall be protected from contamination until ready for use.

6.1 Groundwater Sampling

Groundwater samples for laboratory analysis will be collected from monitor wells installed at the Base Gas Station. Groundwater sample collection procedures will follow standard procedures outlined in Section 5.0 of the QAPP. Sample containers, preservation, and holding time requirements for the analytical parameters are summarized in Table 6-1.

The air in the breathing zone will be checked with a PID each time a well cap is removed prior to well activity. Each well shall be inspected for signs of tampering or other damage. If tampering is suspected, it will be recorded on the Field Activity Daily Log, on the sampling form, and the reported to the Principal Investigator. Wells that are suspected to have been tampered with will not be sampled until the matter has been cleared by the Principal Investigator or the Project Manager. Each well will be measured with an interface probe to collect water level data and to check for and measure LNAPL thickness. The forms of recording data are in Appendix B of the QAPP. The field geologist will calculate the volume of water for the well bore volume and the total for three well bore volumes of groundwater needed to purge the well.

Before the start of sampling activities, plastic sheeting will be placed on the ground surrounding the well. Remove any water in the well protective casing before venting and purging the well. Well purging will consist of evacuation of water until the groundwater has low turbidity (i.e., is clear) and the groundwater parameters (temperature, pH, and conductivity) have stabilized. Purging and sampling of the wells will be performed in a manner that minimizes agitation of sediment in the well and formation. Equipment will not be allowed to free fall into the well.

The groundwater sample names, the number of analytical samples to be collected at each location, the laboratory analysis, and quality control (QC) samples to be collected are shown on Table 3-1. Field analytical tests and methods for groundwater samples are shown on Table 3-4. The number and the frequency of groundwater field analytical methods are shown on Table 3-4.

Table 6-1
Analytical Methods
Base Gas Station Naval Air Station Fort Worth
Fort Worth, Texas
Project No.: 765725

Media	Analytical Parameter	Method	Required Container	Preservation Method	Holding Extraction	Holding Analysis
Soil	PAHs	EPA 8310	1.4 inch x 8 inch core liner with end caps or 1 x 8 oz. glass jar	Ice to 4°C	7 days	40 days
Soil	BTEX	EPA 8020	1.4 inch x 4 inch core liner with end caps or 1 x 4 oz. glass jar	Ice to 4°C	7 days	--
Soil	Total Petroleum Hydro-carbons	EPA 418.1	1.4 inch x 8 inch core liner with end caps or 1 x 8 oz. glass jar	Ice to 4°C	28 days	--
Soil	Lead	EPA 7421	1.4 inch x 4 inch core liner with end caps or 1 x 4 oz. glass jar	Ice to 4°C	180 days	--
Soil	Ammonia	350.2	8 oz. glass jar	Ice to 4°C		28 days
Soil	Phosphorus	365.3	8 oz. glass jar	Ice to 4°C		28 days
Soil	TKN	EPA 351.4	8 oz. glass jar	Ice to 4°C		28 days
Ground water/ surface water	PAH	EPA 8310	2 * 1 liter glass bottle with Teflon®-lined cap	Ice to 4°C	7 days	40 days
Ground water/ surface water	BTEX	EPA 8020	3 40 ml glass vials with Teflon®-lined septum	Ice to 4°C HCl to pH <2	14 days	--

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Table 6-1
Analytical Methods
Base Gas Station Naval Air Station Fort Worth
Fort Worth, Texas
Project No.: 765725

Media	Analytical Parameter	Method	Required Container	Preservation Method	Holding Extraction	Holding Analysis
Ground water/ surface water	Total Petroleum Hydro-carbons	EPA 418.1	2 * 1 liter glass bottle with Teflon®-lined cap	Ice to 4°C Sulferic acid, pH < 2	28 days	
Ground water/ surface water	Lead	EPA 7421	500 ml plastic bottle	Ice to 4°C HNO_3 to pH <2	180 days	--
Ground water	Nitrate	EPA 352.1	500 ml plastic bottle	Ice to 4°C	2 days	--
Ground water	Sulfate	EPA 375.4	500 ml plastic bottle	Ice to 4°C	28 days	--
Ground water	Methane	Modified RSKSOP 175, 114, 147	4 * 20 ml VOA vials (No headspace)	Ice to 4° C	--	14 days
Ground water	Alkalinity	310.1	1 * 250 ml polyethylene	Ice to 4° C		14 days
Ground water	TDS	EPA 160.1	1 * 250 ml polyethylene	Ice to 4° C		7 days

The temperature, pH, conductivity, and turbidity will be measured and recorded after removing each well casing volume during purging. Representative groundwater is presumed to have been obtained when:

- A minimum of three casing volumes of water have been removed from the well.
- The groundwater turbidity has decreased so that the water is clear to the unaided eye and is relatively free of suspended sediments.
- Field measurement of the water for pH is within 0.1 standard unit of the previous reading.
- Field measurement of the water specific conductivity is within 5 percent of the previous reading.
- Field measurement of the water temperature is within 1°C of the previous reading.

In addition to the information required in Chapter 8.0, the following information shall be recorded each time a well is purged and sampled (forms are in Appendix B of the QAPP). This information shall be encoded in IRP Information Management System (IRPIMS) files when required: (1) depth to water before and after purging, (2) well bore volume calculation,(3) sounded total depth of the monitor well, (4) the condition of each well, including visual (mirror) survey, (5) the thickness of any nonaqueous layer, and (6) field parameters, such as pH, temperature, specific conductance, and turbidity.

6.1.1 Water Level Measurement

An interface probe shall be used if a nonconductive floating product layer is suspected in the well. The interface probe shall be used to determine the presence of floating product, if any, prior to measurement of the groundwater level. The groundwater level shall then be measured to the nearest 0.01 foot using an electric water level indicator. Water levels will be measured from the notch located at the top of the casing and recorded on the well sampling form. If well casings are not notched, measurements will be taken from the north edge of the top of the well casing, and a notch will be made with using a decontaminated metal file. Following water level measurement, the total depth of the well from the top of the casing will be determined using the interphase probe and recorded on the well sampling form. The water level depth will then be

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subtracted from the total depth of the well to determine the height of the water column present in the well casing. Ground water field sampling forms located in Appendix B of the QAPP.

The volume of a one foot section of the well borehole (F) can also be calculated using the formula:

$$F = pi(D/2)^2 \times 7.48 \text{ gal/ft}^3$$

where:

D= the inside diameter of the well borehole in feet.

Following water level measurement, the total depth of the well from the top of the casing shall be determined using a weighted tape or electric sounder and recorded on the well sampling form in Appendix B of the QAPP. The water level depth shall then be subtracted from the total depth of the well to determine the height of the water column present in the well casing. All water level and total depth measuring devices shall be routinely checked at least annually with a tape measure to ensure measurements are accurate.

6.1.2 Groundwater Sample Collection

Before collecting groundwater samples, the sampler will don clean, phthalate-free protective gloves. Samples to be analyzed for volatile organic compounds (VOC) will be collected first using a bottom-filling disposable PVC bailer. Samples to be analyzed for volatile or gaseous constituents will not be withdrawn with pumps that exert a vacuum on the sample. Disposable nylon rope will be used to lower and retrieve the bailers. A new length of nylon rope will be used for each for each well, and the rope and bailer will be disposed of after sampling activities. Each bailer will be equipped with a decontaminated, disposable stainless steel leader so that the rope does not contact the water in the well.

VOC sample bottles will have been prepared by the laboratory with hydrochloric acid preservative. The sample will be collected from the bailer using a slow, controlled pour down the side of a tilted sample vial to minimize volatilization. The sample vial will be filled until a meniscus is visible and immediately sealed. When the bottle is capped, it will be inverted and gently tapped to ensure no air bubbles are present in the vial. Vials with trapped air will be

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refilled until no bubbles are present in the vial. These samples will never be composited, homogenized, or filtered.

An initial groundwater sample will be collected at least 24 hours after completion of monitoring well development. Subsequent samples may be collected when scheduled. A groundwater sample may not be collected until three well bore volumes have been removed and the temperature, pH, and conductivity have stabilized. The sample will then be collected immediately after the water level has recovered to 80 percent of its static level or 8 hours after completion of purging, whichever comes first. The samples will be collected from each well with a decontaminated, dedicated, disposable polyethylene bailer. The field geologist will record measurements on a groundwater sample collection log (see Appendix B of QAPP) all pertinent information from the well being developed; the water level; the groundwater parameters measured after each well volume removed; and total volume removed.

Following collection of VOC samples, remaining water samples will be collected in the following order: PAH, TPH, metals, sulfate, nitrate, and field analytical methods for ferrous iron, carbon dioxide, and sulfide. The pH of preserved sample will be checked by pouring a small amount of a non-VOC water sample onto pH paper. The paper will not touch the inside of the container. The preservation checks will be documented in the chain-of-custody forms. One preserved VOC sample a day that will not be submitted for laboratory analysis will be checked with pH paper to verify proper preservation.

Water samples for metals requiring filtering will be filtered through a 0.45 micron membrane within five minutes after sampling and before preservation. Exposure of samples to atmospheric oxygen will be kept to a minimum. In-line filtration and use of disposable filter assemblies will be used.

6.2 Subsurface Soil Sampling

6.2.1 Soil Boring Sampling Procedures

Soil samples will be collected for further characterization of soil geophysical properties and petroleum hydrocarbon concentrations during installation of boreholes which will be completed

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as monitoring wells. Soil sample selected for laboratory analysis will be labeled and stored in accordance with procedures described in Section 5.3 to 5.5 of the QAPP.

Each soil sample will be visually examined by a certified geologist experienced with the station's lithology. Samples will be described in accordance with American Society for Testing and Materials (ASTM) D-2487 (USCS) and the Munsell Color Chart. All information regarding soil texture, consistency, and color shall be recorded on drilling logs. Additional information recorded on the drilling log will be soil sampling location, the method of sampling, the percent recovery of the sample, the depth to first water encountered, and the results of field screening.

Soil samples contained in sleeves will be field screened with a PID to obtain qualitative data on the location of soils potentially impacted with petroleum hydrocarbons. Each sample collected from a boring will be observed for physical evidence of contamination, such as staining or presence of residues. Samples will be collected over a 2-foot interval, visually examined, and quickly sealed with Teflon® tape and capped with a vinyl or polyethylene cap. The remaining portion of the sample contained in the third brass sleeve will be placed in a resealable plastic bag for field screening. Each jar and bag will be marked with the boring number, depth of sample collected, and time of sample collection. Headspace concentrations in the plastic bags will be checked after 10 minutes by puncturing the bag with the PID probe, measuring the headspace concentration in the bag, and recording the PID reading and time on the borehole log. Preprinted labels with IRPIMS-generated sample numbers will be placed on the jars and remaining sample information placed on the label, including depth of sample, date, and time. The samples will be stored dry in a cooler at 4°C while on site.

Samples will be selected for laboratory analysis based on field screening results. One sample from the vadose zone with the highest PID reading will be sent for laboratory analysis. A second soil sample from the vadose zone groundwater interface will also be selected for laboratory analysis.

The soil sample locations, number of samples to be collected at each location, the laboratory analysis, and QC samples to be collected are shown in Table 3-1.

Four geotechnical samples will be collected from selected intervals from soil borings BGSMW02 and BGSMW04 in both the vadose zone and the saturated zones. The geotechnical samples will be collected in thin-walled Shelby tubes, the ends of the Shelby tube sealed with wax, and the sample labeled before submittal for analysis. Geotechnical sample analysis is provided in Table 3-7.

6.2.2 Subsurface Soil Coring Sampling Procedures

Soil samples will be visually examined by a certified geologist experienced with the station's lithology. Samples will be described in accordance with ASTM D-2487 (USCS) and the Munsell Color Chart. All information regarding soil texture, consistency, and color shall be recorded on drilling logs. Additional information recorded on the borehole log will be soil sampling location, the method of sampling, the percent recovery of the sample, the depth to first water encountered, and the results of field screening.

Field screening of the soil samples with a PID will provide qualitative information on the location of soils potentially impacted with petroleum hydrocarbons. Each sampled collected from a boring will be observed for physical evidence of contamination, such as staining or presence of residues. The soil cores will be collected in clear PET or CAB liners of either 24 or 48 inches in length. The length will be determined in the field by the supervising geologist. The cores will be visually examined through the clear liner for soil properties classification and visual hydrocarbon staining. The interval selected for soil analysis will be isolated from the rest of the core by cutting the sample (including the liner) from the rest of the core using a decontaminated knife. The ends of each sample tube will be covered with Teflon® tape and capped with a vinyl or polyethylene cap. The exterior of the cap will be taped to the tube holding the sample, the sample will be labeled accordingly, and stored in a cooler at the site at 4°C before submittal to the laboratory for analysis.

PID readings for field screening will be taken at the exposed ends of the sample. The remaining portion of each sample will be placed in a resealable plastic bag for field screening. Each jar and bag will be marked with the boring number, depth of sample collected, and time of sample collection. Headspace concentrations in the plastic bags will be checked after 10 minutes by puncturing the bag with the PID probe, measuring the headspace concentration in the bag, and recording the PID reading and time on the borehole log.

The soil probe sample names, the number of samples to be collected at each location, the laboratory analysis, and QC samples to be collected are shown in Table 3-2.

Soil samples submitted for laboratory analysis from the soil boring will be from the depth of highest soil headspace concentration in the vadose zone and the soil located at the saturated zone. Laboratory analysis for soil samples is discussed in Chapter 4.0.

6.2.3 Horizontal Conduit Soil Probe Sampling Procedures

Assessment of soil along suspected horizontal conduit locations will be performed using soil probe methods to detect the presence or absence of fuel contaminants. The horizontal conduit soil assessment will be performed with a sequence of six soil probe transects extending along buried utility lines as shown in Figure 3-3. Each transect will have several locations where the soil probe unit will collect soil samples for visual characterization of soil properties and the presence of petroleum hydrocarbons determined by visual observation and field screening techniques. Several attempts to push the soil probe close to the subsurface utility may have to be taken at each transect sampling location.

Soil samples collected from fill materials adjacent to the buried utility will be collected and submitted for laboratory analysis as described in Section 2.4.1. Soil samples will be visually examined by a certified geologist experienced with the station's lithology. Samples will be described in accordance with ASTM D-2487 (USCS) and the Munsell Color Chart. All information regarding soil texture, consistency, and color shall be recorded on drilling logs. Additional information recorded on the drilling log will be soil sampling location, the method of sampling, the percent recovery of the sample, the depth to first water encountered, and the results of field screening.

Field screening of the soil samples with a PID will provide qualitative information on the location of soils potentially impacted with petroleum hydrocarbons. Each sampled collected from a boring will be observed for physical evidence of contamination, such as staining or presence of residues. The soil cores will be collected in clear PET or CAB liners either 24 or 48 inches in length. The cores will be visually examined through the clear liner for soil properties classification and visual hydrocarbon staining. The interval selected for soil analysis will be isolated from the rest of the core by cutting the sample (including the liner) from the rest of the core using a decontaminated knife. The ends of each sample tube will be covered with Teflon® tape and capped with a vinyl or polyethylene cap. The exterior of the cap will be taped to the tube holding the sample, the sample will be labeled accordingly, and stored in a cooler in the field at 4°C before submittal to the laboratory.

PID readings for field screening will be taken at the exposed ends of the sample. The remaining portion of each sample will be placed in a resealable plastic bag for field screening. Each jar and bag will be marked with the boring number, depth of sample collected, and time of sample collection. Headspace concentrations in the plastic bags will be checked after 10 minutes by puncturing the bag with the PID probe, measuring the headspace concentration in the bag, and recording the PID reading and time on the borehole log.

Soil samples submitted for laboratory analysis from the soil cores will be selected from the depth of highest soil headspace concentration and one sample from the invert elevation of the buried utility pipe. Laboratory analysis for soil samples is discussed in Chapter 4.0. The horizontal conduit soil probe names, the number of samples to be collected at each location, the laboratory analysis, and QC samples to be collected are shown on Table 3-2.

6.3 Surface Soil Sampling

There will be no surface soil samples collected.

6. 4 Surface Water Sampling

Surface water samples for laboratory analysis will be collected from the segment of the West Fork of the Trinity River neatest the Base Gas Station (Figures 3-4 and 3-5) within 8 hours after a rain event if fuel seepage is observed. Surface water sample collection procedures will follow standard procedures outlined later in this section. Sample containers, preservation, and holding time requirements for the analytical parameters are summarized in Table 6-1.

The temperature, pH, conductivity, and dissolved oxygen will be measured and recorded at each surface water sampling location before and after each sample is collected. The surface water sample names, the number of analytical samples to be collected at each location, the laboratory analyses, and QC samples to be collected are shown in Appendix B of the QAPP.

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The samples will be collected from the bank of the river at each surface water location with a decontaminated, long-handled polyethylene pitcher. Samples will be collected at the surface of the water. Sample collection order will be volatile organic compounds (VOC), semivolatile compounds, total petroleum hydrocarbons, and lead.

The background surface water sample, upstream of the seep area, will be collected first. The surface water sample located farthest downstream of the discharge point will be collected second. The third surface water sample will be collected at the observed downstream edge of the observed sheen on the river water. The forth surface water sample will be located at the source of the discharge point (Figure 3-5). Each sampling location will be marked with a stake with the sample location marked on it. The field geologist will record on a specified field form all pertinent information of the surface water sampling location, including; the level of the river water from the top of the bank, any sewers of discharge pipes, the estimated width, depth, and flow rate of the river, the surface water parameters measured with field instruments, instrument calibration, and the samples collected and submitted for analysis.

6.5 Sediment Sampling

There will be no sediment sampling.

6.6 Soil Gas Sampling

There will be no soil gas sampling.

6.7 Indoor Air Sampling

Indoor air sampling is not applicable to the project.

6.8 Sample Handling

6.8.1 Sample Containers

Sample containers are purchased precleaned and treated according to EPA specifications for the methods. Sampling containers that are reused are decontaminated between uses by the EPA-recommended procedures (i.e., EPA 540/R-93/051). Containers are stored in clean areas to prevent exposure to fuels, solvents, and other contaminants. Amber glass bottles are used routinely where glass containers are specified in the sampling protocol. The specific types of containers that are to be used for a specific media sampled are specified in Table 5-1 of the QAPP.

6.8.2 Sample Volumes, Container Types, and Preservation Requirements

Sample volumes, container types, and preservation requirements for the analytical methods performed on AFCEE samples are listed in the QAPP in Table 5-1.

6.8.3 Sample QA/QC Requirements

These requirements are defined and specified in Section 4.4.4 the QAPP.

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TAB

7.0

7.0 Field Measurements

7.1 Parameters

Table 3-4 specified the parameters that will be field measured.

7.2 Equipment Calibration and Quality Control

The specific equipment calibration requirements are specified in Section 6.2 of the QAPP.

7.3 Equipment Maintenance and Decontamination

Preventative maintenance will be completed per Section 10.0 of the QAPP. Decontamination will be in accordance with that specified in Chapter 5.0 of the FSP.

7.4 Field Monitoring Measurements

7.4.1 Groundwater Level Measurements

Water level measurements shall be taken in all wells to determine the elevation of the water table within a single 24-hour period prior to a sampling round or initial well development. These measurements shall be taken after all wells have been installed and developed and their water levels have recovered completely. Any conditions that may affect water levels shall be recorded in the field log.

Water level measurements shall be taken with electric sounders, air lines, pressure transducers, or water level recorders (e.g., Stevens recorder). Devices that may alter sample composition shall not be used. Pressure gauges, manometers, or equivalent devices may be used for flowing wells to measure the elevation of the piezometric surface. All measuring equipment shall be decontaminated according to the specifications in Section 5.12. Groundwater level shall be measured to the nearest 0.01 foot.

Static water levels shall be measured each time a well is sampled, and before any equipment enters the well. If the casing cap is airtight, allow time prior to measurement for equilibration of pressures after the cap is removed. Repeat measurements until water level is stabilized.

7.4.2 Floating Hydrocarbon Measurements

The thickness of hydrocarbons floating in monitor wells shall be measured with an electronic interface probe. Hydrocarbon detection paste, or any other method that may affect water chemistry, shall not be used. When detected, the presence of floating hydrocarbons shall be confirmed by withdrawing a sample with a clear, bottom-fill Teflon bailer.

7.4.3 Groundwater Discharge Measurements

Groundwater discharge measurements shall be obtained during monitor well purging and aquifer testing. Groundwater discharges may be measured with orifice meters, containers of known volume, in-line meters, flumes, or weirs, following the guidelines specified in the *Water Measurement Manual*, Bureau of Reclamation, 1967. If discharge measuring devices are upstream of sample collection points, the devices shall be decontaminated. Measurement devices shall be calibrated using containers of known volume.

7.5 Field Performance and System Audits

The field performance and system audits if conducted will be completed as specified in Section 9.0 of the QAPP.

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TAB

8.0

8.0 Record Keeping

The contractor shall maintain field records sufficient to recreate all sampling and measurement activities and to meet all IRPIMS data loading requirements. The requirements listed in this section apply to all measuring and sampling activities. Requirements specific to individual activities are listed in the section that addresses each activity. The information shall be recorded with indelible ink in a permanently bound notebook with sequentially numbered pages. These records shall be archived in an easily accessible form and made available to the Air Force upon request.

The following information shall be recorded for all field activities: (1) location, (2) date and time, (3) identity of people performing activity, and (4) weather conditions. For field measurements: (1) the numerical value and units of each measurement, and (2) the identity of and calibration results for each field instrument, shall also be recorded. The specific records are specified in the QAPP.

The following additional information shall be recorded for all sampling activities: (1) sample type and sampling method, (2) the identity of each sample and depth(s), where applicable, from which it was collected, (3) the amount of each sample, (4) sample description (e.g., color, odor, clarity), (5) identification of sampling devices, and (6) identification of conditions that might affect the representativeness of a sample (e.g., refueling operations, damaged casing).

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